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(54) LIGHTING DEVICE AND DISPLAY USING IT

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a lighting device applicable to a large screen, thin, light, highly bright and uniformly bright in plane and to provide a display bright even on a large screen, low in power consumption, thin and light.
SOLUTION: A lighting device comprises a plurality of light guide plates 103a-c formed of a pair of opposed plate transparent materials with their ends different in thickness and a plurality of light sources 101a-c, the plurality of light guide plates being optically joined together in such a manner that there are no joints between the thicker ends and the thinner ends and the light sources being located in proximity to the thicker ends of the light guide plates, namely, at the backside of the adjacent light guide plates, wherein an optical member is provided for guiding emitted lights from the light

sources to the end faces of the light guide plates.

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CLAIMS

[Claim(s)]

[Claim 1] Two or more transparent materials which consist of the tabular transparent body with which the thickness of the edge where a couple faces each other at least differs, The edge among the edges of a couple where said two or more transparent materials differ in thickness where are the lighting system constituted from two or more light sources which carried out contiguity arrangement by the edge with the larger thickness among the edges of a couple where the thickness of said transparent material differs, and thickness is large, Thickness combines a small edge with a transparent material with the transparent body with an equal refractive index substantially. Said light source is a location close to the edge of the one where alignment arrangement is carried out and the thickness of said transparent material is

larger. And the lighting system which has been arranged in the location which becomes the rear-face side (the object for an exposure is an opposite hand) of a ****** transparent material, and was further equipped with the optical member which leads the outgoing radiation light from the light source to a transparent material end face near said light source or said light source.

[Claim 2] Two or more transparent materials which consist of the tabular transparent body with which the thickness of the edge where a couple faces each other at least differs, It is the lighting system constituted from two or more light sources which carried out contiguity arrangement by the edge with the larger thickness among the edges of a couple where the thickness of said transparent material differs. In an edge with the larger thickness among the edges of a couple where thickness differs, said transparent material from the width of face by the side of the front face of a transparent material (side for an exposure) Have a lobe to which the width of face by the side of a rear face becomes large, and among the edges of a couple where thickness differs, said two or more transparent materials an edge with smaller thickness, and an edge with larger thickness so that it may be arranged at the rear-face side of the transparent material which said lobe adjoins A refractive index combines with a transparent material with the equal transparent body substantially, and alignment arrangement is carried out. Said light source is the lighting system which is a location close to the end face of said lobe, and has been arranged in the location which changes the rear-face side of an adjacent transparent material, and was equipped with the optical member which leads the outgoing radiation light from the light source to a transparent material end face near said light source or said light source further.

[Claim 3] The lighting system which established the optical whole outgoing radiation side surface of two or more transparent materials for the wrap diffusion plate in the optical outgoing radiation side side of said transparent material in claim 1 and the lighting system according to claim 2.

[Claim 4] The lighting system according to claim 3 which prepared the 0.1-15mm gap and has arranged said diffusion plate between said transparent material front faces.

[Claim 5] To the light which carried out vertical incidence at least, the linearly polarized light is reflected with the linearly polarized light, and the circular polarization of light arranges two or more reflecting plates which a hand of cut reflects as the circular polarization of light of reverse at the rear face of two or more of said transparent materials, respectively. As said diffusion plate The polarization maintenance diffusion plate with which abbreviation maintenance of the polarization condition of the light which passes this is carried out is used. Said two or more transparent materials consist of the **** transparent bodies [target / optical], and the front face consists of flat fields. The structure which confines in the interior the light which equipped the rear face with the minute dip reflector which consisted of the concave surfaces, convexes, or level differences of a large number which have a

detailed inclined plane, and carried out incidence from the end face by total reflection, The lighting system according to claim 3 or 4 constituted so that whenever [angle-of-reflection / of the light which spreads the interior] might be changed according to the minute dip reflector with which the rear face was equipped and might carry out outgoing radiation from a front-face side.

[Claim 6] The lighting system according to claim 5 which is the reflector where the reflector of said reflecting plate consists of metal thin films, such as aluminum and Ag, or a dielectric multilayer.

[Claim 7] said polarization maintenance diffusion plate -- optical -- etc. -- a **** transparence base material -- optical -- etc. -- the lighting system according to claim 5 which carries out distributed formation of the thing which has arranged many **** transparence beads and fixed with transparent resin, the thing in which the transparent and detailed concavo-convex field was formed, the thing in which the hologram diffusion layer was formed, or the part from which a refractive index differs inside the transparent body.

[Claim 8] The display said whose lighting system is a lighting system given in either of claim 1 to claims 7 in the display which consists of a display panel which displays an image by adjusting the amount of transmitted lights of light, and a lighting system which illuminates said display panel from a tooth back.

[Claim 9] The display which said lighting system is a lighting system according to claim 7 from claim 5, and was constituted from a transparent material to which the outgoing radiation light from the light source should carry out incidence of the light source in the display which consists of a display panel which displays an image by adjusting the amount of transmitted lights of light, and a lighting system which illuminates said display panel from a tooth back so that it might be arranged in the direction of the screen lower part.

[Claim 10] The transparence substrate of a couple to which said lighting system is a lighting system given in either of claim 5 to claims 7, and said display panel was joined with the fixed gap so that a transparent electrode forming face might counter, It is the liquid crystal panel which has the liquid crystal layer pinched between these transparence substrates, and an electrical-potential-difference impression means to impress the electrical potential difference corresponding to a picture signal to the pixel of the shape of a matrix formed with the transparent electrode of said transparence substrate. Said liquid crystal panel is a display which is what displays using change of the polarization condition of light which has a polarizing plate in the optical incidence side at least, and carries out incidence to a liquid crystal layer.

[Claim 11] The display characterized by the reflection factor to the light which contains aluminum, Ag, etc. in non-opening of said liquid crystal panel using 60% or more of a metal thin film or a dielectric multilayer in a display according to claim 10.

[Claim 12] Claim 10 characterized by constituting so that the linearly polarized light of the request which penetrates the polarizing plate which has arranged the cholesteric-

liquid-crystal layer or the linearly polarized light separation component, and the phase contrast plate, and has been arranged to the optical incidence side of said liquid crystal panel between said liquid crystal panel and two or more transparent materials which constitute said lighting system may be irradiated at said liquid crystal panel, and a display according to claim 11.

[Claim 13] Between said light source and the end face of said transparent material in which the outgoing radiation light from said light source carries out incidence It has a polarization conversion means to change into the linearly polarized light which turns into s-polarized light to the minute dip reflector in which the outgoing radiation light from said light source was formed at the rear face of said transparent material. Said liquid crystal panel Claim 10 characterized by having arranged the transparency shaft of the polarizing plate by the side of optical incidence so that the linearly polarized light which turns into s-polarized light to the minute dip reflector formed in the rear face of said transparent material may penetrate to the illumination light from said lighting system, and a display according to claim 11.

[Claim 14] In a display according to claim 13, said light source is a fluorescent lamp. It is the lamp cover which the optical member which leads the outgoing radiation light from said light source to said transparent material end face becomes from the reflecting plate arranged so that the perimeter of the light source except said direction of a transparent material end face may be covered. A polarization component which penetrates the specific linearly polarized light which said polarization conversion means has arranged to the end face of said transparent material in which the outgoing radiation light from the light source carries out incidence, and is different from this is a display characterized by consisting of a linearly polarized light separation means to reflect.

[Claim 15] The display according to claim 14 with which it is characterized by said polarization separation means carrying out laminating arrangement of a cholesteric-liquid-crystal layer and the phase contrast plate toward a transparent material from a linearly polarized light separation component or the light source.

[Claim 16] Said light source is LED (Light Emitting Diodes) in which plurality carried out alignment arrangement in the display according to claim 13. The optical member which leads the outgoing radiation light from said light source to said transparent material end face converges the outgoing radiation light from said LED. Are two or more parallel-ized lenses, and said polarization conversion means is arranged at the end face of said transparent material in which the outgoing radiation light from said light source (LED) carries out incidence. Two or more polarization separation sides which divide into two different polarization the outgoing radiation light from said two or more LED to which said polarization conversion means passed said two or more lenses by an echo and transparency, It has two or more reflectors which reflect said light reflected in respect of polarization separation in the same direction as the light which penetrated said polarization separation side. Two or more of said polarization

separation side and said two or more reflectors are a display which alignment arrangement is carried out by turns and characterized by having the phase contrast plate which is changing one [at least] polarization condition between two different polarization separated with said polarization part rear face, and arranges the condition of polarization.
[Claim 17] A display given in either of claim 8 to claims 16 characterized by having the control circuit which controls independently burning of two or more light sources arranged to the end face of two or more transparent materials which constitute said lighting system, and putting out lights based on the response of said display panel or said liquid crystal panel.
[Claim 18] A lighting system given in either of claim 1 to claims 17 characterized by really fabricating said two or more transparent materials, or a display.
[Claim 19]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the lighting system which can carry out outgoing radiation of the illumination light with the high homogeneity within a field of a thin shape, a light weight, high brightness, and brightness, and the display equipped with this, also when it big-screen-izes especially about the lighting system used for the lighting of the display which displays an image, and the display using this by adjusting the amount of transmitted lights of light.
[0002]
[Description of the Prior Art] Indicating equipments are media which tell human being information visually, and serve as an existence important for human being and society in the present age used as an advanced information society.
[0003] A display is divided roughly and can be classified into the display of luminescence molds, such as CRT (Cathode Ray Tube) and PDP (Plasma DisplayPanel), and the display of nonluminescent molds, such as a liquid crystal display, ECD (Electrochromic Display), and EPID (Electrophoretic Image Display).
[0004] The display of a nonluminescent mold displays an image by adjusting the transparency (or echo) quantity of light of light, the engine performance of a liquid crystal display [especially] improved remarkably in this in recent years, and it was adopted more often as displays, such as a personal computer.
[0005] Generally, a liquid crystal display can be classified into a transparency mold and a reflective mold, with the liquid crystal display of a transparency mold, equips the tooth back of a liquid crystal panel with a lighting system, and is raising the visibility

of the display screen by the light irradiated from a lighting system.
[0006] A liquid crystal panel is divided roughly and has two methods of the liquid crystal panel by the active-matrix actuation using switching elements, such as TFT (Thin Film Transistor), and the liquid crystal panel of multiplexer actuation. There is an IPS (In PlanSwitching) liquid crystal panel which realized TN (Twisted Nematic) liquid crystal panel and the wide-field-of-view angle as a liquid crystal panel by active-matrix actuation. Moreover, as a liquid crystal panel of multiplexer actuation, there is a STN (Super Twisted Nematic) liquid crystal panel etc. All hold a liquid crystal layer with a glass substrate, arrange a polarizing plate on the both sides, and display by modulating the polarization condition of the linearly polarized light which carries out incidence to a liquid crystal layer.
[0007] The non-display sections between an electrode, a switching element, or a pixel etc. (non-opening) exist in such a liquid crystal panel, and it has become the cause of brightness lowering of a display.
[0008] Moreover, each liquid crystal display has the technical problem that an image will fade and deteriorate, if an animation is displayed. It is said that this is produced since a liquid crystal display is the means of displaying which continues displaying the same image within one frame and which is called the so-called hold mold (Ishiguro et al, Shingaku Giho, EID 96-4, pp.19-26 (1996)). The thing of the time amount of one period of a video signal is meant in one frame here. The mechanism of dynamic-image degradation by this hold type of display is explained as follows. That is, the body which runs by the real image, for example continues moving every moment, and does not stop at the same location. On the other hand, although the image in a right location is displayed on the existing flash of one frame since it continues being displayed on the same location between one frame even if it is the body which runs by the display of a hold mold, a different image from the actual condition will continue being displayed on another flash. Since human being's eyes equalize and recognize them, an image will fade.
[0009] It is reported that only the flash which is blinking a lighting system to this problem displays an image, loses dotage of the image by the above equalization, and improves the image quality of a dynamic image (KSueoka et al, IDRC'97 pp 203-206 (1998)). On the other hand, as a lighting system, there are an edge light method (transparent material method), a direct lower part type (reflecting plate method), and a source method of sheet-like light (liquid crystal display technical p252-256 Sangyo Tosho Publishing , Inc. date-of-issue November 8, 1996, full color liquid crystal display technical p201-202 Triceps, Inc. date-of-issue 1990 year 2 month 26 day).
[0010] The edge light method and the direct lower part type are mainly used for the liquid crystal display more than a medium size among these.
[0011] An edge light method consists of diffusion plates arranged on the transparent material which consists of the transparent bodies, such as an acrylic which processed the rear face, the linear light source which has been arranged to the end face of a

transparent material, and which consists of a fluorescent lamp, for example, and the front face (optical outgoing radiation side) of a transparent material. Incidence of the light which carried out outgoing radiation from the fluorescent lamp (light source) is carried out to a transparent material, and it spreads the inside of a transparent material. The light which spreads the inside of a transparent material is irradiated by illumination sides, such as a liquid crystal panel display, after a travelling direction changes, carrying out outgoing radiation from a transparent material front face by processing performed to the transparent material rear face and equalizing the angular distribution of the illumination light with a diffusion plate.

[0012] A direct lower part type arranges the light source directly under [, such as a liquid crystal panel display,] an illumination side, and in order to improve the homogeneity of brightness in the upper part of a reflecting plate and the light source, it is the lower part of the light source with the configuration which has arranged the optical screen into which permeability was changed according to the distance from the light source, and the diffusion plate. Incidence is carried out to an optical screen or a diffusion plate, quantity of light distribution and the angular distribution of the illumination light are equalized, and the outgoing radiation light from the light source is irradiated by illumination sides, such as a liquid crystal panel display, after reflecting with the reflecting plate arranged in the direct or light source lower part.

[0013] Moreover, the lighting system of a configuration of having arranged the light source in the location which a rear face arranges two or more transparence transparent materials to which the front face where the diffusion plate has been arranged has the reflective [protection from light-cum-] section for an inclined plane in nothing and this inclined plane at a flat surface, and serves as a reflective [protection from light-cum-] section underside of the transparent material which is the end of the thick section of this transparent material, and adjoins is indicated by JP,63-21906,U. In this configuration, it reflects in the reflective [protection from light-cum-] section of a transparent material, and outgoing radiation of the light which carried out incidence to the direct transparent material among the outgoing radiation light from the light source is carried out as illumination light through a diffusion plate. Moreover, after carrying out incidence to a transparent material after reflecting in the reflective [protection from light-cum-] section arranged at the adjoining transparent material rear face, and reflecting in the reflective [protection from light-cum-] section, outgoing radiation of a part of light which did not carry out direct incidence to a transparent material among the outgoing radiation light from the light source is carried out as illumination light through a diffusion plate.

[0014] In the liquid crystal display equipped with such a lighting system, since the great portion of power consumption is the power consumption in the light source of a lighting system, it is necessary to raise the utilization effectiveness of the outgoing radiation light from the light source for low-power-izing of a liquid crystal display, or a raise in brightness. However, the outgoing radiation light from the above-mentioned

conventional lighting system was unpolarized light, and since 50% or more was absorbed in the polarizing plate of a liquid crystal panel, high efficiency for light utilization was not able to be desired.

[0015] On the other hand, in the polarizer given in JP,2,509,372,B, the technique of changing efficiently into specific polarization the outgoing radiation light from the light source which is unpolarized light using the cholesteric-liquid-crystal layer which has GURANJAN structure, and the mirror which makes reverse the hand of cut of the circular polarization of light is indicated. This polarizer is constituted from a phase contrast plate (quarter-wave length plate) which carried out laminating arrangement by the light source, a specular reflection mirror, a cholesteric-liquid-crystal layer, and this.

[0016] A cholesteric-liquid-crystal layer shows the unique optical property based on helical molecular arrangement, the light which carried out incidence to the helical shaft at parallel reflects the circular polarization of light of the hand of cut corresponding to a spiral hand of cut in the wavelength corresponding to the pitch of a cholesteric spiral, and another side shows the selective reflection of penetrating.

[0017] It follows, for example, a right-handed-circularly-polarized-light component penetrates a cholesteric-liquid-crystal layer among the outgoing radiation light from the light source which is unpolarized light when a cholesteric-liquid-crystal layer reflects the counterclockwise circular polarization of light (following, left-handed circularly-polarized light) by penetrating the clockwise circular polarization of light (following, right-handed circularly polarized light), and a left polarization component is reflected. According to an operation of a phase contrast plate, the light which penetrated the cholesteric-liquid-crystal layer is changed into the desired linearly polarized light. On the other hand, in the case of an echo by the specular reflection mirror, although it reflects by the specular reflection mirror and the left-handed circularly-polarized light reflected in the cholesteric-liquid-crystal layer goes to a cholesteric-liquid-crystal layer again, since the hand of cut of the circular polarization of light serves as the right-handed circularly polarized light of reverse, shortly, it penetrates a cholesteric-liquid-crystal layer and is changed into the desired linearly polarized light according to an operation of a phase contrast plate. That is, since the outgoing radiation light from the light source turns into the right-handed circularly polarized light ideally [all], a cholesteric-liquid-crystal layer is penetrated and it can change into the desired linearly polarized light according to an operation of a phase contrast plate further, conventionally, it is absorbed with the polarizing plate of a liquid crystal panel, and the light which was useless can be used effectively.

[0018]

[Problem(s) to be Solved by the Invention] The lighting system of the above-mentioned edge light method has the features that the homogeneity of brightness is high, thin-shape-izing of the thickness which is diameter extent of the light source (fluorescent lamp) is possible, and heat cannot get across to liquid crystal further

easily. For this reason, this method is adopted especially as the notebook sized personal computer as which a thin thing is required. However, the utilization effectiveness of light source light is lower than a direct lower part type, and disadvantageous for a raise in brightness. Moreover, it is necessary to increase the number of the light sources to make the lighting system of an edge light method correspond to a big screen which exceeds 20 inches of vertical angles, and to thicken a transparent material. In this case, the technical problem that the volume becomes large and weight becomes heavy according to that the incidence effectiveness of the light source light to a transparent material falls to one end face of a transparent material by arranging two or more light sources, and the utilization effectiveness of light source light falls further and thickness buildup of a transparent material occurs. On the other hand, the lighting system of a direct lower part type is realizable by the easy approach the response to big-screen-izing increases the number of the light sources, by making an optical design suitable, high brightness is obtained and utilization effectiveness of light source light can also be made higher than a transparent material method. However, the technical problem that the homogeneity within a field of brightness is not so good as that several times are needed and-izing cannot be carried out [thin shape] and the edge light method of the magnitude (for example, fluorescent lamp diameter) of the light source has the thickness of a lighting system.

[0019] moreover, with the lighting system of a publication, to JP,63-21906,U While dividing into the magnitude which needs a transparent material, supposing two or more and arranging the light source to the each Even if the illumination light more uniform than a direct lower part type is obtained and the area of an illumination side becomes large further even when lighting area is large since it constituted so that the direct light of the light source might not result in the lighting section, the whole can be thin-shape-ized by increasing the number of partitions of a transparent material.

[0020] However, with the lighting system of the above-mentioned official report, although it is unstated in any way about the bond part of two or more transparent materials, only by merely putting two or more transparent materials in order, in the joint of a transparent material, the outgoing radiation angular distribution of the illumination light differs from luminance distribution, and the technical problem that it is difficult to obtain the uniform illumination light all over the optical outgoing radiation side of a lighting system actually occurs. Furthermore, it consists of above-mentioned configurations so that incidence of a part of outgoing radiation light from the light source is carried out to a direct transparent material, other parts may be reflected in the reflective [protection from light-cum-] section arranged at the adjoining transparent material rear face and incidence may be carried out to a transparent material, but since other light does not have the way which carries out incidence to a transparent material, they cannot be used effectively but has the technical problem that the utilization effectiveness of light source light is low.

[0021] This invention was made in view of the above-mentioned actual condition, even if it applies the object to a big screen liquid crystal panel, it is lightweight and it is to offer [a thin shape and] a lighting system with the high homogeneity within a field of high brightness and brightness.
[0022] Moreover, as above-mentioned, non-opening which does not contribute to the display between an electrode, a switching element, or a pixel etc. existed in the liquid crystal panel, and non-[these] opening had become the cause of brightness lowering of a liquid crystal panel. Since most of these non-openings were metal electrodes especially in the case of the liquid crystal panel of active-matrix actuation, it reflected and the light which carried out incidence to non-opening had returned to the lighting system. If the light which returned to the lighting system is the lighting system of for example, a direct lower part type, it will reflect with a diffusion plate, an optical screen, or a reflecting plate, and it will be again irradiated by the liquid crystal panel. However, since depolarization or a polarization condition changed and 50% or more of light was again absorbed with the diffusion plate etc. in the polarizing plate arranged at the optical incidence side of a liquid crystal panel, the light re-irradiated by the liquid crystal panel hardly contributed to brightness.
[0023] Then, even if other objects of this invention are liquid crystal panels with a low numerical aperture, they are at achievement and coincidence of the above-mentioned object to offer the lighting system which aimed at the deployment of light by irradiating a liquid crystal panel again where polarization is maintained for the reflected light from non-opening of a liquid crystal panel, and the liquid crystal display using this.
[0024] Furthermore, it changes into polarization of a request of the outgoing radiation light from the light source of a lighting system, and is in offering a brighter and low power liquid crystal display by reducing the optical absorption in a liquid crystal panel.
[0025] By the way, there is the approach of blinking a lighting system as an approach of controlling degradation of the dynamic image of the liquid crystal display which is the means of displaying of a hold mold as above-mentioned. However, after it scanned the whole surface of a liquid crystal panel and the liquid crystal of the whole liquid crystal panel surface answered, since this approach turned on a lighting system, it needed to raise remarkably a scan time and the response time of liquid crystal. Moreover, since the burning time amount of a lighting system was short, luminescence reinforcement needed to be raised for attaining brightness equivalent to the former.
[0026] high [which can display a dynamic image without sense of incongruity when this invention was made in view of this actual condition and the object offers the lighting system which can carry out region rate lighting of the screen independently] -- it is in offering a brightness liquid crystal display.
[0027] Other objects of this invention will become clear from explanation of the below-mentioned example.
[0028]

[Means for Solving the Problem] The summary of this invention which solves the above-mentioned technical problem is as follows.

[0029] Two or more transparent materials which the lighting system of this invention becomes from the tabular transparent body with which the thickness of the edge where a couple faces each other at least differs, The edge among the edges of a couple where two or more transparent materials differ in thickness where are the lighting system constituted from two or more light sources which carried out contiguity arrangement by the edge with the larger thickness among the edges of a couple where the thickness of said transparent material differs, and thickness is large, Thickness combines a small edge with a transparent material with the transparent body with an equal refractive index substantially. The light source is a location close to the edge of the one where alignment arrangement is carried out and the thickness of said transparent material is larger. And it is arranged in the location which becomes the rear-face side (the object for an exposure is an opposite hand) of a ****** transparent material, and has further the optical member which leads the outgoing radiation light from the light source to a transparent material end face near said light source or said light source.

[0030] Moreover, two or more transparent materials which another lighting system of this invention becomes from the tabular transparent body with which the thickness of the edge where a couple faces each other at least differs, It is the lighting system constituted from two or more light sources which carried out contiguity arrangement by the edge with the larger thickness among the edges of a couple where the thickness of a transparent material differs. In an edge with the larger thickness among the edges of a couple where thickness differs, a transparent material from the width of face by the side of the front face of a transparent material (side for an exposure) Have a lobe to which the width of face by the side of a rear face becomes large, and among the edges of a couple where thickness differs, two or more transparent materials an edge with smaller thickness, and an edge with larger thickness so that it may be arranged at the rear-face side of the transparent material which said lobe adjoins A refractive index combines with a transparent material with the equal transparent body substantially, and alignment arrangement is carried out. Said light source is a location close to the end face of said lobe, and is arranged in the location which changes the rear-face side of an adjacent transparent material, and is further equipped with the optical member which leads the outgoing radiation light from the light source to a transparent material end face near said light source or said light source.

[0031]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on some examples, referring to a drawing.

[0032] (Example 1) drawing 1 shows an example of the lighting system of this invention, and the display which used this -- it is an outline sectional view a part. This

display consists of a liquid crystal panel 200 which displays an image by adjusting the amount of transmitted lights of light, and a lighting system 100 arranged at the tooth back.

[0033] The display panel which displays an image can be used by adjusting the amount of transmitted lights of the light which carries out incidence as a liquid crystal panel 200, especially, it is long lasting and the liquid crystal panel in which a matrix display is possible can be used.

[0034] As a display mode of a liquid crystal panel 200 ** GH (Guest Host) mode, PC () [Phase] Change mode, TN () [Twisted] Nematic The mode, STN () [Super] Although Twisted Nematic mode, ECB (Electrically Controlled Birefringence) mode, PDLC (Polymer Dispersed Liquid Crystal) mode, etc. can be used It is desirable when using the mode which displays in modulating the polarization condition of the light which carries out incidence to a liquid crystal layer by low driver voltage, using a polarizing plate as a display mode with which a high contrast ratio is obtained realizes the good display of image quality.

[0035] Moreover, the liquid crystal panel by the active-matrix actuation divide a liquid crystal panel 200 roughly and using switching elements, such as TFT (Thin Film Transistor), As what there are two methods with the liquid crystal panel of multiplexer actuation, and displays by modulating the polarization condition of the light which carries out incidence to a liquid crystal layer TN (Twisted Nematic) liquid crystal panel, The liquid crystal panel by the active-matrix actuation of an IPS (In Plane Switching) liquid crystal panel, a MVA (Multi-domain Vertical Aligned) liquid crystal panel, etc. which realized the wide-field-of-view angle, Or liquid crystal panels of multiplexer actuation, such as a STN (Super Twisted Nematic) liquid crystal panel, can be used.

[0036] Here, although the case of TN liquid crystal panel is explained below, this invention is not limited to this.

[0037] The 1st transparence glass substrate 204 with which laminating formation of the light filter, transparent electrode, and luminous-intensity-distribution film which do not illustrate a liquid crystal panel 200 was carried out, The 2nd transparence glass substrate 202 which has switching elements, such as an electrode connected with the luminous-intensity-distribution film which is not illustrated, the transparent electrode which forms a pixel, and this, and a thin film transistor, It has the liquid crystal layer 208 which the dielectric anisotropy enclosed through the frame-like sealing compound 203 between these two transparence glass substrates 204,202 becomes from a forward nematic liquid crystal. The direction of orientation is specified on the orientation film formed on two transparence glass substrates 204,202 by performing orientation processing of rubbing etc., and the 90 degrees of the directions of the liquid crystal molecule major axis of the liquid crystal layer 208 are in the distorted condition continuously between transparence glass substrates. in the illumination-light plane of incidence of the transparence glass substrate 202, and the optical

outgoing radiation side of the transparence glass substrate 204, it arranges so that the linearly polarized light the linearly polarized light and a polarizing plate 201 and the polarizing plate 205 cross at right angles mutually, respectively may be penetrated -- having -- the direction of orientation of the liquid crystal molecule major axis in the transparence glass substrate 202 and the transparence glass substrate 204 -- the transparency shaft of the linearly polarized light of a polarizing plate 201 and a polarizing plate 205 -- receiving -- both -- parallel -- or it constitutes so that it may both intersect perpendicularly.

[0038] If it considers as a polarizing plate 201,205, what gave the protective layer of triacetyl cellulose can be used for both sides of the film which the polyvinyl alcohol made to extend was made to absorb iodine, and gave the polarization function, and it pastes up so that it may be optically combined with the transparence glass substrate 202 and the transparence glass substrate 204 by acrylic adhesives, respectively. Although the linearly polarized light which penetrated the polarizing plate 201 among the light which carried out incidence from liquid crystal panel 200 tooth back passes the liquid crystal layer 208 and it carries out incidence to a polarizing plate 205 by the above-mentioned configuration, the polarization condition of the light which penetrates the liquid crystal layer 208 can be changed with the electrical potential difference impressed to the liquid crystal layer 208 in this case. For this reason, the polarization condition of the light which passes the liquid crystal layer 208 can be changed, the quantity of light which penetrates a polarizing plate 205 can be controlled by impressing the electrical potential difference corresponding to image information to the transparent electrode on the transparence glass substrate 202,204, and impressing electric field to the liquid crystal layer 208, and an optical image can be formed by it.

[0039] Next, a lighting system 100 is explained. Two or more transparent materials 103 (the inside of drawing 103a, 103b, 103c) in which the lighting system 100 carried out alignment arrangement, Two or more light sources 101 (the inside of drawing 101a, 101b, 101c) which are arranged, respectively on one side face (end face) of two or more transparent materials 103, and have the luminescence length corresponding to the side-face (end face) die length, Two or more lamp covers 102 (the inside of drawing 102a, 102b, 102c) arranged, respectively so that the part except the transparent material 103 direction of two or more light sources 101 may be covered, Two or more reflecting plates 104 (the inside of drawing 104a, 104b, 104c) arranged through an air space, respectively at the rear face (field of a liquid crystal panel 200 and an opposite hand) of two or more transparent materials 103, It consists of diffusion plates 105 arranged so that the whole surface may be covered to the front-face (field by the side of liquid crystal panel 200) side of two or more transparent materials 103 (103a-103c).

[0040] That is, a lighting system 100 carries out alignment arrangement of two or more unit lighting systems 1000 (the inside of drawing 1000a, 1000b, 1000c) which

consist of a transparent material 103, the light source 101 arranged on one side face (end face) of a transparent material 103, a lamp cover 102, and a reflecting plate 104 arranged at the rear face of a transparent material 103, and consists of diffusion plates 105 arranged so that the whole surface may be covered to the front-face side.

[0041] Here, in order to raise the homogeneity of the luminance distribution within a field of the illumination light from a lighting system 100, it is important for a unit lighting system that the homogeneity of the luminance distribution within a field of the illumination light obtained when alignment arrangement of two or more unit lighting systems is carried out is also high not to mention the homogeneity of the luminance distribution within a field of the illumination light of each unit lighting system being high.

[0042] In order to realize this, when the lighting system of this invention carried out two or more alignment arrangement of the unit lighting system, it was constituted so that the level difference by the side of the front face of two or more transparent materials which constitute a unit lighting system (liquid crystal panel 200 side), and a joint might be lost substantially.

[0043] That is, in case the transparent material which constitutes a unit lighting system is constituted from the tabular transparent body with which the thickness of the end face which a couple faces differs and alignment arrangement of two or more transparent materials is carried out, an end face with large thickness and an end face with small thickness are joined. Moreover, the light source is a location close to an end face with the larger thickness among the end faces which the couple from which the thickness of a transparent material differs faces, and is arranged in the location used as the rear face of a ****** transparent material. If it does in this way, since the light source will not serve as a failure at the time of carrying out alignment arrangement of two or more transparent materials, two or more transparent materials can carry out alignment arrangement in the condition that there are not a level difference and a clearance in the front-face side.

[0044] Furthermore, the joint of transparent materials is connected so that it may join together optically. Here, it is realizable by meaning abolishing the refractive-index difference in an interface substantially by filling with the transparent body of the same refractive index substantially with the transparent body which constitutes a transparent material for the interface of transparent materials as joining together optically, for example, pasting up transparent materials with acrylic adhesives.

[0045] Since according to this configuration there is no level difference by the side of the front face of the transparent materials which constitute a unit lighting system (liquid crystal panel 200 side) and a joint is lost optically, a lighting system with the more uniform luminance distribution within a field is realizable.

[0046] Next, it explains more concretely about the unit lighting system which constitutes this lighting system 100. Drawing 2 is the perspective view showing the outline of the unit lighting system 1000 which constitutes a lighting system 100.

[0047] The unit lighting system 1000 is arranged on one side face (end face) 1031 of a transparent material 103 and a transparent material 103, and consists of the light source 101 which has the luminescence length corresponding to the side-face (end face) die length, a lamp cover 102 arranged so that the part except the direction of transparent material 103 end face of the light source 101 may be covered, and a reflecting plate 104 arranged through an air space at the rear face (field of a liquid crystal panel 200 and an opposite hand) of a transparent material 103. A transparent material 103 consists of the tabular transparent bodies with which the cross-section configuration from which the thickness in the end face 1031 and end face 1032 which a couple faces differs carried out the rectangle as above-mentioned. Moreover, among the end faces which the couple from which the thickness of a transparent material 103 differs faces, thickness is a location close to the end face 1301 of the larger one, and when the light source 101 joins two or more transparent materials 103, it is arranged in the location acting as a failure, i.e., the lower field of an end face 1031, (a liquid crystal panel 200 is the field of an opposite hand).

[0048] The light source 101 is good to use what fulfills small, high luminous efficiency, and the conditions of low generation of heat, for example, can use what carried out alignment arrangement of two or more fluorescent lamps, such as a cold cathode tube and a hot cathode tube, or LED (Light Emitting Diodes). Here, it is tube diameter phi2.6mm first. The case where a cold cathode fluorescent lamp is used is explained. The cold cathode fluorescent lamp which has an emission peak wavelength can be used for the wavelength of 453nm, 544nm, and 611nm that what is necessary is just to use the so-called three-wave tubing which has an emission peak wavelength corresponding to the transparency spectrum of the light filter of a liquid crystal panel 200 as a cold cathode fluorescent lamp used here.

[0049] Here, the light source 101 is arranged to the lower field of the end face 1031 of a transparent material 103 as above-mentioned. When this carries out alignment arrangement of two or more unit lighting systems 1000, in order to lose the joint of two or more transparent materials, and the level difference by the side of a transparent material front face (liquid crystal panel 200 side), it is for enabling it to arrange to the rear-face side of the transparent material which constitutes the unit lighting system which adjoins each other in the light source.

[0050] therefore, the magnitude (here diameter of a cold cathode fluorescent lamp) of the light source -- d -- carrying out -- the thickness of the end face 1031 of a transparent material 103, and an end face 1032 -- respectively -- t1 and t2 ** -- when it carries out, it is desirable to fill the following relation.

[0051]

t1>d+t2 -- (several 1)

Moreover, in order to raise the incidence effectiveness to the transparent material 103 of the light which carries out outgoing radiation from the light source 101, it is desirable for the magnitude of a light source light-emitting part to be smaller than the

cross section of the end face 1301 by the side of the light source of a transparent material.

[0052] Drawing 3 is 2.6mm of tube diameters as the light source. It is drawing showing an example of the relation between effective thickness t (=t1−t2) of the light source side edge side of a transparent material at the time of using a fluorescent lamp, and the illumination−light brightness which carries out outgoing radiation from a transparent material. The illumination light brighter as the effective thickness of a transparent material end face is larger than the tube diameter of the light source is obtained a passage clear from drawing 3 . However, when a transparent material is thickened, there is a problem that the thickness and weight of a lighting system increase. Then, the effective thickness of a transparent material end face takes [that lifting of the brightness of the illumination light is saturated with about 1.2 to 1.5 times of a light source tube diameter, and] an example, and it is the thickness t1 of magnitude (here diameter of cold cathode fluorescent lamp) d of the light source, and the end face 1031 of a transparent material. Thickness t2 of an end face 1032 It is more desirable to make it fill the following relation.

[0053]

1.5*d>t1−t2>1.2*d -- (several 2)

Here, they are t1 =4.5mm and t2 =1mm. It carried out, and it has arranged so that the center position of the light source 101 may be located in height of 1.75mm from the rear face of a transparent material.

[0054] A lamp cover 102 can use the reflecting plate which carried out the configuration which has opening in the parts of the cylindrical shape which it is and is the perimeter of the light source 101, and has been arranged with a gap into the part except the transparent material 103 end−face section so that the light source 101 may be covered, or an ellipse cartridge for carrying out incidence of the outgoing radiation light from the light source 101 to a transparent material 103 efficiently, or a reflective film.

[0055] What laminated what specifically formed silver and metal thin film layers, such as aluminum, by vacuum deposition or the sputtering method on the surface of the high polymer film as a lamp cover 102 in support plates, such as a high polymer film sheet and an aluminum plate, can be used. Here, it is 0.2mm in thickness about what carried out sputtering of the silver to PET (polyethylene terephthalate). The aluminum plate was pasted and what was fabricated was used.

[0056] A reflecting plate 104 is arranged so that the whole rear−face surface of a transparent material 103 may be covered, and it has the function to reflect the light from transparent material 103 rear face in a transparent material 103 side. The thing in which the reflector which has a high reflection factor as a reflecting plate 104 was formed on support base materials, such as a glass plate, a metal plate, a resin plate, or a high polymer film, can be used. the increase of a thing [to which the reflector formed the metal thin film with the high reflection factor of aluminum, silver, etc. by

vacuum deposition or the sputtering method on the support base material], or support base material top -- an echo -- the film -- the thing which formed the dielectric multilayer so that it might become, or the thing which carried out the coat of the white pigments on the support base material can be used. Moreover, the thing it was made to function as a reflecting plate by carrying out two or more layer laminating of the transparence medium by which refractive indexes differ may be used.

[0057] Here, the PET (polyethylene terephthalate) film was used as a support base material for small [of equipment], and lightweight-izing, and what formed the silver metal thin film as a reflector was used.

[0058] A transparent material 103 consists of tabular transparent acrylic resin with which the thickness in the end face 1031 and end face 1032 which a couple faces differs as above-mentioned, changes whenever [angle-of-reflection / of the configuration which confines in the interior the light which carried out incidence from the end face 1031 by total reflection, and the light which spreads the interior], and uses what has the structure which carries out outgoing radiation of the light to a liquid crystal panel 200 side.

[0059] Here, whenever [angle-of-reflection / of the light which spreads the interior of a transparent material] was changed, and what is realized in the concavo-convex field of a large number which have the detailed inclined plane in which the structure to which outgoing radiation of the light is carried out was formed to the field by the side of the rear face of a transparent material (a liquid crystal panel 200 and opposite hand), or the minute dip reflector constituted from a level difference was used.

[0060] drawing 4 shows an example of a transparent material 103 -- it is a sectional view a part. the surface 103C constitutes the transparent material 103 illustrated to drawing 4 from a flat field -- having -- the rear face -- abbreviation -- it consists of flat principal plane 103B and flat minute dip reflector 103A formed in one side of two or more triangular grooves. Principal plane 103B of the rear face of a transparent material 103 spreads the light 300 which carried out outgoing radiation from the light source 101 and which carried out incidence to the transparent material by total reflection between surface 103C of a transparent material, and it is constituted so that it may shut up in the interior. Moreover, minute dip reflector 103A of the rear face of a transparent material 103 has the function to which outgoing radiation of a part of light which spreads the inside of a transparent material 103 is carried out from surface 103C of a transparent material 103 by changing whenever [angle-of-reflection]. Although minute dip reflector 103A may constitute a specular reflection side by metal thin films, such as aluminum and silver, or the dielectric multilayer, even if it adds an exceptional reflective member and does not constitute a reflector, a function can fully be achieved by the echo by the refractive-index difference of air and acrylic resin.

[0061] Here, it is a refractive index 1.49 as a transparent material 103. Using acrylic resin, minute dip reflector 103A on the rear face of a transparent material formed the

direction of a major axis so that it might become parallel to the direction of a major axis of the light source 101, and it cost whenever [to surface 103C of a transparent material 103 / average pitch / of minute dip reflector 103A / of P= 200 micrometers / average height / of h= 10 micrometers /, and average tilt-angle] for theta= 40 degrees.

[0062] Moreover, to the thickness of the end face 1031 by the side of the light source 101 of a transparent material 103, the thickness of the end face 1032 which faces this consisted of making principal plane 103B of transparent material 103 rear face incline to surface 103C of a transparent material 103 so that it might become thin.

[0063] In addition, are low in height h of dip reflector 103A in the place near the light source 101. It is made to change continuously so that it may become high in a location distant from the light source 101. Dip reflector 101A A pitch P Or change theta continuously with the distance from the light source 101 whenever [tilt-angle]. Or it is good to raise the homogeneity of the light which constitutes the thickness of a transparent material 103, i.e., the distance of surface 103C of a transparent material, and principal plane 103B on the back, so that it may become thin in nonlinear according to the distance from the light source, and carries out outgoing radiation from a transparent material 103. Under the present circumstances, when two or more transparent materials are joined, it is good to constitute so that the light spread from an adjacent transparent material may also be taken into consideration and the homogeneity within a field of brightness may become high.

[0064] Moreover, in order to use effectively the light which carried out incidence to the transparent material 103, it is good for the side face (end face) except the front face of a transparent material 103, a rear face and the end face 1031 by the side of the light source, and this and the end face 1032 which counters to form the reflector which is not illustrated and to make it the light which carried out incidence not leak in a transparent material.

[0065] According to this configuration, although between principal plane 103B on surface 103C of a transparent material 103 and the rear face of a transparent material is spread repeating total reflection, the light which resulted in dip reflector 103A among the light which spreads the inside of a transparent material changes whenever [angle-of-reflection], and, as for the outgoing radiation light 300 from the light source 101 which carried out incidence to the transparent material 103, separates from them and carries out outgoing radiation of the total reflection conditions by transparent material surface 103C. Although it becomes the light which had breadth in the longitudinal direction (ridgeline) of the ramp of the shape of a triangular groove from which the light which carried out outgoing radiation from the transparent material 103 constitutes dip reflector 103A, in the direction vertical to the longitudinal direction of dip reflector 103A, the light whose half power angle is about **10 degrees and which was formed into abbreviation parallel is obtained. In addition, the configuration of a transparent material 103 may spread the light in which

the rear face carried out incidence to the transparent material between surface 103C by total reflection, and may have detailed and continuous wave-like or stair-like structure which consists of principal plane 103B which makes the structure to shut up, and two or more minute dip reflector 103A as it will not be limited to this configuration and will be illustrated to drawing 5 or drawing 6 , if the above-mentioned function is filled.

[0066] The diffusion plate 105 is arranged so that the whole surface may be covered to the front-face (field by the side of liquid crystal panel 200) side of the transparent material 103 (103a-103c) of two or more unit lighting systems 1000 (1000a-1000c).

[0067] The diffusion plate 105 changes the angular distribution of the light which carried out outgoing radiation from the transparent material 103 (103a-103c), and luminance distribution, and has the function which raises the angular distribution of the illumination light irradiated to a liquid crystal panel 200, and the homogeneity of the luminance distribution within a field.

[0068] The opaque white color part material which distributed white pigments can be used into transparence members, such as a thing which formed irregularity in the front face of transparent high polymer films, such as PET and PC (polycarbonate), as a diffusion plate 105, a thing in which the diffusion layer which mixed the particle to which a refractive index differs from the transparent body in the transparent body was formed on the front face of a high polymer film, a thing which mixed air bubbles in the interior of a film, and gave diffusibility, or an acrylic.

[0069] The more it enlarges distance on the diffusion plate 105 and the front face of a transparent material, the more it becomes impossible in addition, to check by looking change of the luminance distribution within a field of the illumination light in the joint which joined the unit lighting system. Although specifically based also on the diffusibility of the diffusion plate 105, if it is the diffusion plate which has the realistic permeability to which effectiveness is not reduced, it will become impossible to check by looking change of the luminance distribution within a field of the illumination light in the joint which joined 0.1mm - about 15mm, then a unit lighting system for the distance of the diffusion plate 105 and transparent material 103 front face, and the illumination light with the higher homogeneity of the luminance distribution within a field will be obtained.

[0070] In addition, although it is not necessary to necessarily arrange if the angular distribution of the illumination light and the homogeneity of the luminance distribution within a field are high even if the diffusion plate 105 does not have this, it is usually needed.

[0071] Next, actuation of this display is explained. After reflecting by direct or the lamp cover 102 (102a-102c), incidence of the light which carried out outgoing radiation from the light source 101 (101a-101c) is carried out to a transparent material 103 (103a-103c). Although the light which carried out incidence to the transparent material 103 (103a-103c) spreads the inside of a transparent material,

repeating total reflection, the light which reached the dip reflector on the rear face of a transparent material among the light which spreads the inside of a transparent material changes whenever [angle-of-reflection], and separates from them and carries out outgoing radiation of the total reflection conditions on a transparent material front face. The light which carried out outgoing radiation from the transparent material 103 (103a-103c) is irradiated by the liquid crystal panel 200 after quantity of light distribution and the angular distribution of the illumination light are equalized with the diffusion plate 105.

[0072] The amount of transmitted lights is controlled according to image information, and, as for the light irradiated by the liquid crystal panel 200, an image is displayed.

[0073] Here, in the lighting system of this invention, distance to the width of face of a transparent material, i.e., the light source side edge side of a transparent material, and this and the end face which counters cannot be depended on the magnitude of a liquid crystal panel display, but can be set up short. If the width of face of a transparent material generally becomes short, it becomes easy to make high homogeneity of the luminance distribution within a field of the illumination light, and the brightness of the illumination light by which outgoing radiation is carried out from one more transparent material can be made high.

[0074] that is, -- if the brightness of the illumination light per unit lighting system is made high by making width of face of a transparent material small -- the homogeneity of the luminance distribution within a field -- high -- more -- high -- the lighting system which carries out outgoing radiation of the brightness light is realizable.

[0075] Furthermore, there is no level difference by the side of the front face of the condition which carried out alignment arrangement of two or more unit lighting systems 1000, i.e., two or more transparent materials which constitute the unit lighting system 1000 (1000a-1000c) also as a lighting system 100, and since alignment arrangement is carried out in the condition that there is nothing optically, a joint can obtain the illumination light with the high homogeneity within a field of brightness.

[0076] Moreover, since it can respond by increasing the number of unit lighting systems even if a screen size becomes large, the thickness of a lighting system does not become thick.

[0077] Therefore, with the lighting system of this invention, even when enlargement (big-screen-izing) is attained by carrying out alignment arrangement of two or more unit lighting systems which consist of the light source, a transparent material, a lamp cover, and a reflecting plate, high brightness and the luminance distribution within a field can carry out outgoing radiation of the uniform illumination light by the thin light weight. The display with which the high definition display with the uniform luminance distribution within a field is obtained by the thin light weight and high brightness is realizable by furthermore using this lighting system.

[0078] In addition, when using the lighting system concerning this example, it is desirable to consider as the configuration shown in drawing 7 from the following

reasons. Drawing 7 is the outline perspective view showing the lighting system of this example, and the display which used this. When the transparent material concerning this example does not form in a minute dip reflector the reflector where a metal thin film etc. is exceptional, the direction where the brightness of the illumination light which carries out outgoing radiation from a transparent material becomes the highest turns into a direction to which it inclined several times from [of a transparent material] the surface perpendicular. That is, it becomes the direction to which 5-10 degrees of directions which will become [display brightness] the highest if it arranges so that the light source may be located in screen down to the transparent material which the outgoing radiation light from the light source should carry out [the physical relationship of the transparent material which constitutes a unit lighting system as shown in drawing 7 , and the light source] incidence inclined up to screen perpendicular 200A. As for this, it is dramatically effective to observe from a lower part by the monitor a common display, especially for computers, when breaking and distributing efficiently a limited light for which is not almost and improvement in the visibility from the upper part is called for in the direction of an observer. That is, in this example, the luminous intensity distribution of the limited light are carried out effectively, and it can be used efficiently. In addition, although this example showed the case where the number of unit lighting systems was three, it could not be overemphasized that the response of this invention in a broad screen size is attained by it not being limited to this and increasing the number of unit lighting systems to arbitration.

[0079] Moreover, although the above-mentioned example explained the case where a minute dip reflector was formed, as structure of the rear face of a transparent material, what carried out patterning of the diffuse reflector in white-pigments ink etc. may be used for the rear face of a transparent material. Under the present circumstances, the rate of surface ratio of a diffuse reflector of making it change corresponding to the distance from the light source 101 for equalization of the quantity of light irradiated by the liquid crystal panel is good.

[0080] Also in this case, the same effectiveness as the above-mentioned example is acquired.

[0081] namely, -- the case where enlargement (big-screen-izing) is attained by carrying out two or more alignment arrangement of the unit lighting system which consists of the light source, a transparent material, a lamp cover, and a reflecting plate -- a thin shape -- it is -- and the luminance distribution within a field -- uniform -- high -- the lighting system which carries out outgoing radiation of the brightness light is realizable, it is more bright and the display which can perform the high-definition display with the high homogeneity within a field of brightness can be realized.

[0082] (Example 2) drawing 8 shows other examples of the lighting system of this invention, and a display -- it is an outline sectional view a part. This example is what

transformed a part of above-mentioned example, the sign same about the part which has the same function as the above-mentioned example is attached, and detailed explanation is omitted about the same part.

[0083] Although two or more transparent materials which constitute a unit lighting system were optically combined in the above-mentioned example, the transparent material which really fabricated two or more transparent materials which should constitute a unit lighting system from the start in this example is used.

[0084] Drawing 9 is the perspective view of the transparent material of this example. If the transparent material 103 which really fabricated two or more transparent materials from the start is used as shown in drawing 9 , since the level difference by the side of the front face of two or more transparent materials which should realize a unit lighting system, and a joint will be lost thoroughly, the illumination light with the more uniform luminance distribution within a field can be obtained. Furthermore, since components mark become fewer, productivity goes up and the effectiveness that cost falls can also be expected.

[0085] (Example 3) Other examples of the lighting system applied to this invention next and a display are explained, referring to a drawing.

[0086] the part where drawing 10 shows other examples of the lighting system of this invention, and a display -- an outline sectional view -- it is -- drawing 11 -- some lighting systems 100 of this example -- an outline sectional view and drawing 12 are the outline perspective views of the transparent material which constitutes the unit lighting system 1000 of this example.

[0087] This example is what transformed some lighting systems 100 explained in (the example 1), the sign same about the part which has the same function as the above-mentioned example is attached, and detailed explanation is omitted about the same part.

[0088] This example has the structure where the part the light source light of two or more transparent materials 103 (103a-103c) which constitute the unit lighting system 1000 (1000a-1000c) carries out [a part] incidence is arranged at the rear face of a transparent material at which projection and this lobe 103L and the light source 101 (101b, 101c) adjoin each other rather than a part for a transparent material joint, in the lighting system explained in the example 1 (drawing 1) as shown in drawing 10 and drawing 11 .

[0089] Therefore, the width of face Lr by the side of a rear face (a liquid crystal panel 200 and opposite hand) is longer than the width of face Ls by the side of a front face (liquid crystal panel side), and the level difference is formed by the end face 10311 in which the light source light of a transparent material 103 carries out incidence, and the junction end face 10312 with an adjacent transparent material as the transparent material 103 which constitutes the unit lighting system 1000 is shown in drawing 12 .

[0090] The front face and the rear face are an abbreviation flat side, and lobe 103L of a transparent material 103 has structure spread while the light source light which

carries out incidence from an end face 10311 repeats total reflection. Moreover, like the transparent material which explained the part except lobe 103L in the example 1 (drawing 4 – drawing 6), the front face consists of flat fields, and two or more minute dip reflectors are constituted by the rear face.

[0091] Here, in the part near the light source, the quantity of light of illumination light which generally carries out outgoing radiation from a transparent material may increase, and it may serve as a failure at the time of attaining equalization of the field interior division cloth of brightness. At this example, the part near the light source of a transparent material leading to this luminance distribution ununiformity is made to project, and by arranging at the rear face of an adjacent transparent material, as only the high part of the homogeneity within a field of brightness is used for actual lighting, the illumination light with the higher homogeneity of the field interior division cloth of brightness is obtained.

[0092] Lobe 103L of the light source 101 and a transparent material 103 is arranged at the rear face of an adjacent transparent material as above-mentioned. When this carries out alignment arrangement of two or more unit lighting systems 1000, it is for obtaining the more uniform illumination light by losing the joint of two or more transparent materials, and the level difference by the side of a transparent material front face (liquid crystal panel 200 side), and separating the light source from the part which contributes to lighting actually [a transparent material] further.

[0093] Here, even if it arranges the light source 101 at the rear face of an adjacent transparent material, in order to make it the level difference by the side of a transparent material front face (liquid crystal panel 200 side) not arise, a transparent material 103 is constituted so that the thickness of the end face 1032 which faces this may become thin to the thickness by the side of the incidence of light source light. That is, the principal plane of transparent material 103 rear face inclines to the front face of a transparent material 103. When whenever [this about 10312 end face tilt-angle] is set to beta, it is the wire extension of t13, t2, and lobe 103L about the thickness of an end face 10312 and an end face 1032, respectively L1 When it carries out, in order to make it a level difference not arise at the joint of the transparent materials by the side of a transparent material front face (liquid crystal panel 200 side), it is desirable to fill the following relation.

[0094]

t13>L1*tan beta+t 2 -- (several 3)

Moreover, in order to raise the incidence effectiveness to the transparent material 103 of the light which carries out outgoing radiation from the light source 101, the illumination light brighter as the thickness of an end face 10311 is larger than the tube diameter of the light source is obtained. However, when a transparent material is thickened, there is a problem that the thickness and weight of a lighting system increase. Then, it is more desirable to make it the effective thickness of a transparent material end face fill the relation of the following [thickness / t12 / of magnitude

(here diameter of cold cathode fluorescent lamp) d of the light source and the end face 10311 of a transparent material] with about 1.2 to 1.5 times of a light source tube diameter in view of lifting of the brightness of the illumination light being saturated.

[0095]

1.5*d>t12>1.2*d -- (several 4)

Here, using the fluorescent lamp of d= 2.6mm of tube diameters as the light source 101, it was referred to as t12=3.5mm, t13=1.5mm, and t2=1mm, and it has arranged so that the center position of the light source 101 may be located in height of 1.75mm from the rear face of a transparent material.

[0096] Moreover, wire extension L1 of lobe 103L The homogeneity of the luminance distribution within a field of the illumination light by which outgoing radiation is carried out from a transparent material, so that it is long is a wire extension L1, although it rises. If it becomes long, the problem that carry out that a lighting system becomes thick etc. and equipment is enlarged will arise. For this reason, in view of more than L1 =8mm, then the homogeneity within a field of brightness being mostly saturated with this example, it could be L1 =8mm here.

[0097] According to this configuration, the outgoing radiation light from the light source 101 which carried out incidence to the transparent material 103 passes lobe 103L of a transparent material 103, repeating total reflection, and spreads the inside of a transparent material further. The light which reached the minute dip reflector on the rear face of a transparent material among the light which spreads the inside of a transparent material changes whenever [angle-of-reflection], and carries out outgoing radiation from a transparent material front face.

[0098] Under the present circumstances, to the illumination light which carries out outgoing radiation from a transparent material, and contributes to the lighting of a liquid crystal panel actually, the brightness near the light source is high, and since the part with uneven luminance distribution is not contained, the illumination light with the uniform luminance distribution within a field is obtained.

[0099] The light which carried out outgoing radiation from the transparent material is irradiated by the liquid crystal panel 200 after the angular distribution of the illumination light and the luminance distribution within a field are equalized with the diffusion plate 105.

[0100] The amount of transmitted lights is controlled according to image information, and, as for the light irradiated by the liquid crystal panel 200, an image is displayed.

[0101] the case where enlargement (big-screen-izing) is attained like the above-mentioned example 1 also in this example by carrying out alignment arrangement of two or more unit lighting systems which consist of the light source, a transparent material, a lamp cover, and a reflecting plate -- a thin shape -- lightweight -- and the luminance distribution within a field -- uniform -- high -- the lighting system which carries out outgoing radiation of the brightness light is realizable. Moreover, by using

such a lighting system, it is more bright and the display of various screen sizes with which the high-definition display with the high homogeneity within a field of brightness is obtained can be realized.

[0102] Moreover, especially in this example, since the part near the light source to which the brightness of a transparent material becomes high, and the part which carries out outgoing radiation of the illumination light which contributes to the display of a liquid crystal panel actually are separated, as for the illumination light from a unit lighting system, the homogeneity of the luminance distribution within a field becomes high more.

[0103] Therefore, since it becomes impossible to check it by looking even if change of the luminance distribution within a field of the illumination light in the joint which joined the unit lighting system is shorter than the case where the distance of the diffusion plate 105 and transparent material 103 front face is the above-mentioned example 1, a thinner lighting system and a display are realizable.

[0104] In addition, by the above-mentioned explanation, in order to make it a level difference not arise at the joint of the transparent materials by the side of a transparent material front face (liquid crystal panel 200 side), it was said that it is desirable to fill the relation of (a formula 3).

[0105] however, the dip configuration of transparent material 130 rear face which adjoins each other from the end face 10311 of a transparent material 130 in the field 10313 reached to an end face 10312 as shown in drawing 13 and abbreviation -- that it should be made equal, if the following relation is filled, the level difference of a transparent material joint can be lost -- it comes out and you may make it fulfill this condition

[0106]

tl3>tr+t2 -- (several 5)

Here, it is tr. It is the thickness of a reflecting plate 104.

[0107] By the way, the transparent material which really fabricated from the start two or more transparent materials which were explained with reference to drawing 9 as a transparent material of the lighting system shown in drawing 13 may be used.

[0108] In this case, since there are not a level difference by the side of the front face of two or more transparent materials which should realize a unit lighting system, and a joint thoroughly, the amount of brightness within a field can obtain the more uniform illumination light. Since components mark furthermore become fewer, the effectiveness that cost falls is expectable.

[0109] However, in the case of the configuration of a transparent material shown in drawing 13 , the technical problem that it is difficult to really fabricate a lobe and a clearance with injection molding, and productivity worsens occurs.

[0110] Here, another operation gestalt of the lighting system shown in drawing 13 is explained using drawing 32 . The lighting system shown in drawing 32 consists of two or more wedge-shaped transparent materials 3232 to which the lobe 3233 was

attached by the transparent material with the plate-like transparent material 3231 of one sheet. Alignment arrangement of two or more wedge-shaped transparent materials 3232 is carried out so that it may be arranged at the rear face of a wedge-shaped transparent material at which a lobe 3233 adjoins each other, and it is optically combined with the plate-like transparent material 3231 by acrylic transparence adhesives, and the exterior serves as the same configuration as the lighting system explained with reference to drawing 13 .

[0111] In addition, a sign 3234 is the plane of composition of the plate-like transparent material 3231 and the wedge shape transparent material 3232 with a lobe.

[0112] With especially the gestalt of this operation, since the front-face side of a transparent material consists of plate-like transparent materials 3231 of one sheet and there are not a level difference by the side of the front face of two or more transparent materials which realize a unit lighting system, and a joint, it is effective in the ability of the amount of brightness within a field to obtain the more uniform illumination light.

[0113] Moreover, since the plate-like transparent material 3231 and the wedge-shaped transparent material 3232 can be easily fabricated if it creates separately, productivity does not necessarily fall like [in the case of really fabricating].

[0114] (Example 4) Other examples of the lighting system applied to this invention next and a display are explained, referring to a drawing.

[0115] This example acquires new effectiveness by limiting more the function of a part of configuration member of the lighting system explained in (the example 1), and a display, the sign same about the part which has the same function as the above-mentioned example is attached, and detailed explanation is omitted about the same part.

[0116] drawing 14 shows other examples of the lighting system of this invention, and a display -- it is an outline sectional view a part. This display consists of a display panel 200 which displays an image by adjusting the amount of transmitted lights of light, and a lighting system 100 arranged at the tooth back.

[0117] It is good to use the liquid crystal panel same as a display panel as an example 1. Here, between an electrode, a switching element, or a pixel (clearance between a pixel and a pixel) exists in a liquid crystal panel 200, and these parts serve as the non-display section (non-opening 206), and do not contribute to the brightness of an image. That is, in such a liquid crystal panel, the non-opening 206 leading to optical loss exists inevitably.

[0118] Although the non-[these] opening 206 does not contribute to the brightness of an image, since most is a metal electrode, light is reflected. Although Cr was generally used as a metal electrode in many cases, the liquid crystal panel of this example raised the reflection factor of the light in the non-opening 206 by using aluminum (aluminum) alloy other than Cr (chromium) alloy. It is a rate of surface ratio at the time of seeing from the liquid crystal panel 200 tooth-back side of Cr and

aluminum in the liquid crystal panel 200 specifically applied to this example Cr:aluminum=1:1.4 It carried out. 54% of reflection factors at the time of using only Cr as a metal electrode was able to be raised to 74% of reflection factors by carrying out like this.

[0119] Two or more transparent materials 103 (the inside of drawing 103a-103c) which carried out alignment arrangement like the lighting system which explained the lighting system 100 in (the example 1), Two or more light sources 101 (the inside of drawing 101a-101c) which are arranged, respectively on one side face (end face) of two or more transparent materials 103, and have the luminescence length corresponding to the side-face (end face) die length, Two or more lamp covers 102 (the inside of drawing 102a-102c) arranged, respectively so that the part except the direction of transparent material 103 end face of two or more light sources 101 may be covered, Two or more reflecting plates 104 (the inside of drawing 104a-104c) arranged through an air space, respectively at the rear face (field of a liquid crystal panel 200 and an opposite hand) of two or more transparent materials 103, It consists of diffusion plates 105 arranged so that the whole surface may be covered to the front-face (field by the side of liquid crystal panel 200) side of two or more transparent materials 103 (103a-103c).

[0120] That is, a lighting system 100 carries out alignment arrangement of two or more unit lighting systems 1000 (the inside of drawing 1000a-1000c) which consist of a transparent material 103, the light source 101 arranged on one side face (end face) of a transparent material 103, a lamp cover 102, and a reflecting plate 104 arranged at the rear face of a transparent material 103, and consists of diffusion plates 105 arranged so that the whole surface may be covered to the front-face side.

[0121] Next, a part peculiar to this example is explained in full detail.

[0122] Like an example 1, the reflecting plate 104 of this example is arranged so that the whole rear-face surface of a transparent material 103 may be covered, and it has the function to reflect the light from transparent material 103 rear face in a transparent material 103 side. Especially in this example, the reflecting plate which has the reflector where the polarization condition of the reflected light is maintained is used. The reflector which maintains the polarization condition described here reflects the linearly polarized light to vertical-incidence light with the linearly polarized light at least, and the circular polarization of light is a reflector which the hand of cut reflects as the circular polarization of light of reverse.

[0123] What formed the reflector where polarization is maintained as such a reflecting plate 104 on support base materials, such as a glass plate, a metal plate, a resin plate, or a high polymer film, can be used. the increase of a thing [to which the reflector formed the metal thin film with the high reflection factor of aluminum, silver, etc. by vacuum deposition or the sputtering method on the support base material], or support base material top -- an echo -- the film -- the thing which formed the dielectric multilayer so that it might become, or the thing it was made to function as a

reflecting plate by carrying out two or more layer laminating of the transparence medium by which refractive indexes differ can be used.
[0124] Here, the PET (polyethylene terephthalate) film was used as a support base material for small [of equipment], and lightweight-izing, and what formed the silver metal thin film as a reflector was used.
[0125] The transparent material explained with reference to drawing 4 - drawing 6 in (the example 1) as a transparent material 103 can be used. Namely, the configuration which confines in the interior the light which is the tabular transparent body with which the thickness of the end face 1031 which a couple faces, and an end face 1032 differs, and carried out incidence from the end face 1031 by total reflection, It can change according to the concavo-convex field of a large number which have the detailed inclined plane in which the direction of the light which spreads the interior was formed at the rear face (a liquid crystal panel 200 and opposite hand) of a transparent material, or the minute dip reflector constituted by the level difference, and what was considered as the configuration which carries out outgoing radiation to a liquid crystal panel 200 side can be used.
[0126] Under the present circumstances, it is important for the transparent body which constitutes a transparent material 103 that they are directions [target / the below-mentioned reason to / optical]. As the **** transparent bodies [target / optical], glass and the acrylic resin formed with injection molding can be used. Here, since specific gravity is generally larger than acrylic resin, if glass is the same volume, it will become heavy, and probably, it will be good [glass] to use acrylic resin as a transparent material, since neither processing nor shaping is still as easier as acrylic resin.
[0127] Here, it is a refractive index 1.49 as a transparent material 103. Using what formed acrylic resin with injection molding, minute dip reflector 103A on the rear face of a transparent material formed the direction of a major axis so that it might become parallel to the direction of a major axis of the light source 101, and it cost whenever [to surface 103C of a transparent material 103 / average pitch / of minute dip reflector 103A / of P= 200 micrometers / average height / of h= 10 micrometers /, and average tilt-angle] for theta= 40 degrees.
[0128] Moreover, to the thickness of the end face 1031 by the side of the light source 101 of a transparent material 103, the thickness of the end face 1032 which faces this consisted of making principal plane 103B of transparent material 103 rear face incline to surface 103C of a transparent material 103 so that it might become thin.
[0129] In addition, are low in height h of minute dip reflector 103A in the place near the light source 101. It is made to change continuously so that it may become high in a location distant from the light source 101. Minute dip reflector 101A A pitch P Or change theta continuously with the distance from the light source 101 whenever [tilt-angle]. Or it is good to raise the homogeneity of the light which constitutes the thickness of a transparent material 103, i.e., the distance of surface 103C of a

transparent material, and principal plane 103B on the back, so that it may become thin in nonlinear according to the distance from the light source, and carries out outgoing radiation from a transparent material 103. Under the present circumstances, when two or more transparent materials are joined, it is good to constitute so that the light spread from an adjacent transparent material may also be taken into consideration and the homogeneity within a field of brightness may become high.
[0130] The diffusion plate 105 is arranged so that the whole surface may be covered to the front-face (field by the side of liquid crystal panel 200) side of the transparent material 103 (103a-103c) of two or more unit lighting systems 1000 (1000a-1000c).
[0131] The diffusion plate 105 changes the angular distribution of the light which carried out outgoing radiation from the transparent material 103 (103a-103c), and luminance distribution, and has the function which raises the angular distribution of the illumination light irradiated to a liquid crystal panel 200, and the homogeneity of the luminance distribution within a field.
[0132] Especially in this example, what has the function which diffuses the light which carried out incidence where abbreviation maintenance of the polarization condition is carried out is used. As such a diffusion plate, two or more spherical transparence beads are densely arranged in on a **** transparence [target / optical] base material in the shape of a field. The hologram diffusion plate formed on the **** transparence [target / the thing in which the diffusion layer fixed by transparent resin was formed, or / optical] base material, Or SPIE Vol.1536 Optical LCG (light control glass) of a publication etc. to Materials Technologyfor Energy Efficiency and Solar Energy Conversion X (1991) pp 138-148 It can be used.
[0133] An example of the diffusion plate 105 which has a polarization maintenance function in drawing 15 and drawing 16 is shown. drawing 15 -- some diffusion plates 105 -- a perspective view -- it is -- drawing 16 -- some diffusion plates 105 -- it is a sectional view.
[0134] The polycarbonate film which this diffusion plate 105 formed by glass or the casting method (the solution casting method), On one front face of the **** transparence [target / which consists of polymer films, such as a triacetyl cellulose film, or alicyclic acrylic resin (trade-name OPUTORETTSU: Hitachi Chemical make) formed with injection molding / optical] base material 1501 Only a part arranges densely further the **** spherical transparence [target / which consists of glass or resin / optical] bead 1502 in the shape of a field, and it fixes with transparence adhesion resin 1503, such as acrylic or a polyester system.
[0135] Although the transparence bead 1502 can use an object with a diameter of several micrometers - hundreds of micrometers, in order to plan control of diffusibility ability, and homogeneity in a field, it is desirable to use that to which particle size was equal as much as possible.
[0136] It functions as a diffusion plate because the light 1504 which carried out incidence to the transparence bead 1502 converges and emits this polarization

maintenance diffusion plate 105 according to the refraction operation by transparence bead 1502 interface, and that diffusibility can be designed to arbitration by changing the refractive index of the transparence bead 1502 as shown in drawing 16 .

[0137] Moreover, unlike what was illustrated, what covered the transparence bead 1502 whole by transparence adhesion resin 1503 may be used. In this case, although it is required for the refractive indexes of the transparence bead 1502 and transparence resin 1503 to differ, the transparence bead 1502 has the comparatively easily available thing of refractive indexes 1.5-2.0, and transparence adhesion resin 1503 is a refractive index 1.4-1.6. Since a thing can obtain comparatively easily, the polarization maintenance diffusion plate with which desired diffusibility is acquired can consist of combining these suitably.

[0138] Furthermore, the polarization maintenance diffusion plate 105 which acquired desired diffusibility can also be used by kneading the layer of the transparence bead 1502 two or more [-fold], as shown in drawing 17 .

[0139] Since there is little loss of light since unlike the diffusion plate by the conventional multiple scattering the above-mentioned polarization maintenance diffusion plate used the refraction operation and has obtained dispersion nature by few interfaces, and there is little effect which it has to a polarization condition further, it functions as a diffusion plate which carries out abbreviation maintenance of the polarization condition.

[0140] On the other hand, when using a hologram diffusion plate as a polarization maintenance diffusion plate 105, a photopolymer can be applied on a **** transparence [targets /, such as a triacetyl cellulose film, / glass or the polycarbonate film which formed membranes by the casting method (the solution casting method), / optical] base material, and what be recorded as becoming a desired dispersion property by 2 flux-of-light interference which be a well-known technique can be used. Moreover, a desired hologram pattern may be computed by the calculating machine, and CGH (Computer Generated Hologram) drawn and produced with an electron beam etc. may be used.

[0141] The activity of the hologram of a volume phase mold is desirable at the point that diffraction efficiency with it is acquired. [desirable from fields, such as endurance, and using an acrylic photopolymer as a hologram ingredient and] [high]

[0142] What is necessary is just to use for red the hologram which used Ar+Dye laser for helium-Ne laser and green, used Ar laser for blue, and was produced as the exposure light source that what is necessary is just to make the main diffracted-wave length of a hologram correspond to the bright line spectrum corresponding to the three primary colors of the outgoing radiation light from the light source 101, in order to correspond to the white light. Under the present circumstances, although the laminating of two or more holograms exposed according to the individual may be carried out and they may be used on each wavelength, what carried out multiplex exposure on two or more wavelength may be used for one sheet.

[0143] Moreover, the hologram diffusion plate to which mass production nature has a high polarization maintenance function by the hologram of the release mold created by the approach of forming a hologram pattern with transparent ultraviolet-rays hardening resin etc. on a **** transparence [target / optical] base material may be realized.
[0144] The more it enlarges distance on the diffusion plate 105 and the front face of a transparent material, the more it becomes impossible in addition, to check by looking change of the luminance distribution within a field of the illumination light in the joint which joined the unit lighting system. Although specifically based also on the diffusibility of the diffusion plate 105, if it is a realistic diffusion plate, it will become impossible for change of the luminance distribution within a field of the illumination light in the joint which joined 0.1mm - about 15mm, then a unit lighting system to check the distance of the diffusion plate 105 and transparent material 103 front face by looking, and the illumination light with the high homogeneity of the luminance distribution within a field will be obtained.
[0145] In addition, although it is not necessary to necessarily arrange if the angular distribution of the illumination light and the homogeneity of the luminance distribution within a field are high even if the diffusion plate 105 does not have this, it is usually needed.
[0146] Next, actuation of this display is explained, referring to drawing 14 . After reflecting by direct or the lamp cover 102 (102a-102c), incidence of the light which carried out outgoing radiation from the light source 101 (101a-101c) is carried out to a transparent material 103 (103a-103c). The light which reached the minute dip reflector on the rear face of a transparent material among the light which the light which carried out incidence to the transparent material 103 (103a-103c) spreads the inside of a transparent material, repeating total reflection, and spreads the inside of a transparent material changes whenever [angle-of-reflection], and separates from them and carries out outgoing radiation of the total reflection conditions on a transparent material front face. The light which carried out outgoing radiation from the transparent material 103 (103a-103c) is irradiated by the liquid crystal panel 200 after quantity of light distribution and the angular distribution of the illumination light are equalized with the diffusion plate 105.
[0147] The amount of transmitted lights is controlled according to image information, and, as for the light irradiated by the liquid crystal panel 200, an image is displayed.
[0148] Also in this example, the same effectiveness as the above-mentioned example is acquired. namely, -- the case where enlargement (big-screen-izing) is attained by carrying out alignment arrangement of two or more unit lighting systems which consist of the light source, a transparent material, a lamp cover, and a reflecting plate -- a thin light weight -- it is -- and the luminance distribution within a field -- uniform -- high -- the lighting system which carries out outgoing radiation of the brightness light is realizable, it is more bright and the display which can perform the

high-definition display with the high homogeneity within a field of brightness can be realized.

[0149] Moreover, the non-display sections 206 between an electrode, a switching element, or a pixel etc. (non-opening) exist in a liquid crystal panel 200 as above-mentioned. Although the non-[these] opening 206 does not contribute to the brightness of an image, since most is a metal electrode, light is reflected.

[0150] Therefore, although the light 301 which carried out incidence to the opening 207 among the light irradiated by the liquid crystal panel 200 is used for a display as it is, the light 302 which carried out incidence to the non-opening 206 of a liquid crystal panel 200 does not contribute to a display, but reflects and returns to a lighting system 100.

[0151] The light 302 which returned to the lighting system 100 penetrates the diffusion plate 105 and a transparent material 103, and faces to a reflecting plate 104. It reflects and the light which faced to the reflecting plate 104 is again irradiated by the liquid crystal panel 200 through a transparent material 103 and the diffusion plate 105. Under the present circumstances, at this example, the polarization condition of light does not change a lot by transparency of the diffusion plate 105 and a transparent material 103, and echo with a reflecting plate 104. For this reason, since the light 302 again irradiated by the liquid crystal panel 200 is maintaining mostly the polarization condition when being first reflected by the non-opening 206 of a liquid crystal panel 200, it can be contributed to a display, without absorbing almost with a polarizing plate 201. Namely, in the display of this example, since the light which was shaded by the non-opening 206 of a liquid crystal panel 200, and was not able to contribute to a display is reusable in the condition that there is no big loss, conventionally, even if it is a liquid crystal panel with a low numerical aperture, it is effective in a bright display being obtained.

[0152] When the liquid crystal panel 200 of 70% of numerical apertures was specifically used, brightness improved about 2% to the case where there is no polarization maintenance function in a reflecting plate 104 and the diffusion plate 105. Moreover, when the liquid crystal panel 200 of 40% of numerical apertures was used, similarly brightness improved about 15%. That is, in the lighting system of this example, and the display using this, when what has a numerical aperture low as a liquid crystal panel is used, the effectiveness shows up more notably.

[0153] In addition, although Cr alloy and aluminum alloy were used together as a metal electrode in this example, this invention is not limited to this. That is, it is desirable to stop the optical loss by the optical absorption in the non-opening 206 to the minimum, as the tooth-back side of a liquid crystal panel 200 uses the metal with high reflection factors, such as aluminum and Ag, of an electrode, or forms the reflector by a dielectric multilayer etc. in the liquid crystal panel tooth-back side of the non-opening 206 ideally and the light which carries out incidence to the non-opening 206 is reflected in a lighting-system side with a high reflection factor. [at least]

[0154] (Example 5) Other examples of the lighting system applied to this invention next and a display are explained, referring to a drawing.
[0155] drawing 18 shows other examples of the lighting system of this invention, and the display which used this -- it is an outline sectional view a part.
[0156] In the lighting system which explained this example in (the example 4), and a display Between a liquid crystal panel 200 and the transparent material 103 (103a-103c) which constitutes a lighting system 100 It is what has arranged the cholesteric-liquid-crystal layer 106 and the phase contrast plate (quarter-wave length plate) 107 as a polarization separation means from the liquid crystal panel 200 side in order of the phase contrast plate 107 and the cholesteric-liquid-crystal layer 106, and the same sign is attached to the same part as the above-mentioned example, and detailed explanation is omitted.
[0157] The cholesteric-liquid-crystal layer 106 uses the liquid crystal cell which stored low-molecular cholesteric liquid crystal between two glass substrates by which orientation processing was carried out, and the thing which formed the macromolecule cholesteric-liquid-crystal layer on the transparent substrate in directions [targets /, such as glass or transparency resin, / optical]. The cholesteric-liquid-crystal layer 106 shows the unique optical property based on helical molecular arrangement, the light which carried out incidence to the helical shaft at parallel reflects the circular polarization of light of one hand of cut according to the hand of cut of a cholesteric spiral, and another side shows the selective reflection of penetrating. Therefore, in order to make it the main flux of light which carries out incidence to the cholesteric-liquid-crystal layer 106 become parallel to a helical shaft, the helical shaft of the cholesteric-liquid-crystal layer 106 is constituted so that it may become vertical to the screen of a liquid crystal panel 200. Moreover, since the wavelength region of selective reflection is decided by the pitch of molecular arrangement, in order to make it selective reflection happen in the wavelength of the bright line spectrum corresponding to the three primary colors of the light source 101, it is required [in order to correspond white, selective reflection happens throughout a visible wavelength region, or] to carry out the laminating of two or more cholesteric-liquid-crystal layers from which a pitch differs, and to use them. In addition, it is Asia Display 95 Digest p735 instead of piling up the two or more layers cholesteric-liquid-crystal layer from which a pitch differs, in order to acquire selective reflection throughout a visible wavelength region. The cholesteric-liquid-crystal layer to which a pitch which is indicated was changed continuously may be used.
[0158] The phase contrast plate 107 changes the circular polarization of light which penetrated the cholesteric-liquid-crystal layer 106 into the linearly polarized light which penetrates the polarizing plate 201 by the side of the tooth back of a liquid crystal panel 200 (illumination-light incidence side), i.e., the linearly polarized light whose oscillating direction of the transparency shaft of a polarizing plate 206 and an electric vector corresponded, and what functions as a quarter-wave length plate in a

visible wavelength region is used. The extended high polymer film which has high transmission in a visible wavelength region as a phase contrast plate 107, for example, polyvinyl alcohol, a polycarbonate, Pori Sall John, polystyrene, polyarylate, etc. can be used. In addition, the liquid crystal layer which arranged a mica, Xtal, or a molecule shaft with the one direction, and carried out orientation can be used.

[0159] In addition, although it is difficult to constitute the phase contrast plate which functions as a quarter-wave length plate to the whole region of visible wavelength with one kind of phase contrast plate with the wavelength dependency (wavelength dispersion) of the refractive index of the construction material which generally constitutes a phase contrast plate What is necessary is just to use the phase contrast plate which functions as a quarter-wave length plate in a large wavelength region by sticking at least two kinds of phase contrast plates with which wavelength dispersion differs so that the optical axis may be intersected perpendicularly, constituting.

[0160] Next, actuation of the lighting system of this example and the display using this is explained.

[0161] After reflecting by direct or the lamp cover 102 (102a-102c), incidence of the light which carried out outgoing radiation from the light source 101 (101a-101c) is carried out to a transparent material 103 (103a-103c). The light which reached the minute dip reflector on the rear face of a transparent material among the light which the light which carried out incidence to the transparent material 103 (103a-103c) spreads the inside of a transparent material, repeating total reflection, and spreads the inside of a transparent material changes whenever [angle-of-reflection], and separates from them and carries out outgoing radiation of the total reflection conditions on a transparent material front face. After quantity of light distribution and the angular distribution of the illumination light are equalized with the diffusion plate 105, incidence of the light which carried out outgoing radiation from the transparent material 103 (103a-103c) is carried out to the cholesteric-liquid-crystal layer 106.

[0162] As above-mentioned, the cholesteric-liquid-crystal layer 106 reflects the circular polarization of light of one hand of cut corresponding to the hand of cut of a cholesteric spiral, the selective reflection of penetrating another side is shown, the right-handed-rotation circular polarization of light (following, right-handed circularly polarized light) is penetrated here, and the left-handed-rotation circular polarization of light (following, left-handed circularly-polarized light) explains the case where it reflects.

[0163] Although the light which carried out outgoing radiation from the light source 101 (101a-101c) and which carried out incidence to the cholesteric-liquid-crystal layer 106 through the transparent material 103 (103a-103c) is unpolarized light, a right-handed-circularly-polarized-light component penetrates the cholesteric-liquid-crystal layer 106, and a left-handed-circularly-polarized-light component is reflected. After optical 301A which penetrated the cholesteric-liquid-crystal layer 106 is

changed into the linearly polarized light the linearly polarized light transparency shaft of a polarizing plate 201 and whose oscillating direction of an electric vector corresponded by operation of the phase contrast plate 107, according to it, incidence of it is carried out to a liquid crystal panel 200. On the other hand, the diffusion plate 105 and a transparent material 103 (103a-103c) are passed, it reflects with a reflecting plate 104, and optical 301B reflected in the cholesteric-liquid-crystal layer 106 goes to the cholesteric-liquid-crystal layer 106 again. Under the present circumstances, as for the light which the light which passes the diffusion plate 105 and a transparent material 103 (103a-103c) did not receive big effect in the condition of polarization, and was further reflected with the reflecting plate 104, the hand of cut of the circular polarization of light serves as the circular polarization of light of reverse. For this reason, in the case of an echo, it becomes the right-handed circularly polarized light, and cholesteric-liquid-crystal layer 301B is penetrated shortly, and after optical 301B first reflected in the cholesteric-liquid-crystal layer 106 is changed into the linearly polarized light in a reflecting plate 104 the linearly polarized light transparency shaft of a polarizing plate 201 and whose oscillating direction of an electric vector corresponded according to an operation of the phase contrast plate 107, incidence of it is carried out to a liquid crystal panel 200.

[0164] Therefore, after the outgoing radiation light which is the unpolarized light from the light source 101 is efficiently changed into the desired linearly polarized light, it will be irradiated by the liquid crystal panel 200. Here, the desired linearly polarized light means the linearly polarized light which penetrates the polarizing plate 201 by the side of the illumination-light incidence of a liquid crystal panel 200.

[0165] According to image information, the amount of transmitted lights of the illumination light is controlled by the liquid crystal panel 200, and an image is displayed. Under the present circumstances, the light 301A and 301B which carried out incidence to the liquid crystal panel 200 contributes to a display, without absorbing almost with a polarizing plate 201. That is, since it is absorbed with the polarizing plate 201 of a liquid crystal panel 200 and the light which was useless can be used effectively conventionally, a bright and low power display is realizable. The brightness of the screen improved about 45% with the same power consumption to the case where the lighting system which does not have the cholesteric-liquid-crystal layer 106 and the phase contrast plate 107 actually is used.

[0166] In addition, although it is needless to say, also in this example, the same effectiveness as the above-mentioned example is acquired. namely, -- the case where enlargement (big-screen-izing) is attained by carrying out alignment arrangement of two or more unit lighting systems which consist of the light source, a transparent material, a lamp cover, and a reflecting plate -- a thin light weight -- it is -- and the luminance distribution within a field -- uniform -- high -- the lighting system which carries out outgoing radiation of the brightness light is realizable, it is more bright and the display which can perform the high-definition display with the

high homogeneity within a field of brightness can be realized.
[0167] By the way, optical 302A which carried out incidence to the non-opening 206 of a liquid crystal panel 200 among the light irradiated by the liquid crystal panel 200 does not contribute to a display, but reflects and faces to a lighting system 100 in the beginning. In case the light which faced to the lighting system 106 penetrates the phase contrast plate 107, it turns into the right-handed circularly polarized light in response to the operation, and penetrates the cholesteric-liquid-crystal layer 106. The diffusion plate 105 and a transparent material 103 (103a-103c) are passed, it reflects with a reflecting plate 104 (104a-104c), and the light which penetrated the cholesteric-liquid-crystal layer 106 turns into the left-handed circularly-polarized light. It is reflected in the cholesteric-liquid-crystal layer 106, and the diffusion plate 105 and a transparent material 103 (103a-103c) are passed again, it reflects with a reflecting plate 104 (104a-104c), and optical 302A used as the left-handed circularly-polarized light becomes the right-handed circularly polarized light. Optical 302A used as the right-handed circularly polarized light penetrates the cholesteric-liquid-crystal layer 106 shortly, and after being changed into the linearly polarized light the linearly polarized light transparency shaft of a polarizing plate 201 and whose oscillating direction of an electric vector corresponded according to an operation of the phase contrast plate 107, it carries out re-incidence to a liquid crystal panel 200. Optical 302A which carried out re-incidence to the liquid crystal panel 200 contributes to a display, without absorbing almost with a polarizing plate 201. Therefore, since the light which reflected by the non-opening 206 of a liquid crystal panel 200 at first, and was not able to contribute to a display is also reusable, even if it is a liquid crystal panel with a low numerical aperture, it is effective in a bright display being obtained.
[0168] In addition, although the diffusion plate 105 has been arranged at the tooth back of the cholesteric-liquid-crystal layer 106 in the above-mentioned explanation, if the location of the diffusion plate 105 is between a liquid crystal panel 200 and a transparent material 103 (103a-103c), it will be good anywhere and will not be limited to the above-mentioned example.
[0169] (Example 6) The example of the lighting system of the others which start this invention next, and the display using this is explained using a drawing. drawing 19 shows an example of the lighting system of this invention, and the liquid crystal display which used this -- it is an outline sectional view a part. In the lighting system explained in (the example 5), and the display using this, this examples are the cholesteric-liquid-crystal layer 106 and the thing which has arranged the phase contrast plate 108 and the linearly polarized light separation component 109 from the liquid crystal panel 200 side instead of the phase contrast plate 107 in order of the linearly polarized light separation component 109 and the phase contrast plate 108, and attach the same sign to the same part as the above-mentioned example, and detailed explanation is omitted.
[0170] The linearly polarized light separation component 109 penetrates a specific

linearly polarized light component among the light which carries out incidence to this, a different polarization component from this has the function to reflect, and various the configuration is considered.
[0171] For example, the international disclosure number of international application: The birefringence reflective mold polarization film which carried out two or more layer laminating of the birefringence high polymer film from which a publication differs to WO 95/27919 by turns, and SID92 Digest p427 The vertical angle of a publication can use what formed in a two-sheet pile and its superposition section the polarization separation side according the prism array which are 90 abbreviation to a dielectric multilayer.
[0172] In addition, the transparency shaft of the linearly polarized light of the linearly polarized light separation component 109 is arranged so that it may be in agreement with the transparency shaft of the linearly polarized light of the polarizing plate 201 by the side of the tooth back of a liquid crystal panel 200.
[0173] With the linearly polarized light separation component 109, the phase contrast plate 108 has the function to change into the circular polarization of light the linearly polarized light reflected or penetrated, and functions as a quarter-wave length plate in a visible wavelength region. As a phase contrast plate 108, it is transparent in a visible wavelength region, and the extended high polymer film with high transmission, for example, polyvinyl alcohol, a polycarbonate, Pori Sall John, polystyrene, polyarylate, etc. can be used. In addition, the liquid crystal layer which arranged a mica, Xtal, or a molecule shaft with the one direction, and carried out orientation can be used.
[0174] In addition, although it is difficult to constitute the phase contrast plate which functions as a quarter-wave length plate to the whole region of visible wavelength with one kind of phase contrast plate from a wavelength dependency (wavelength dispersion) of the refractive index of the construction material which generally constitutes a phase contrast plate The phase contrast plate which functions as a quarter-wave length plate in a large wavelength region can consist of sticking at least two kinds of phase contrast plates with which wavelength dispersion differs so that the optical axis may be intersected perpendicularly.
[0175] Next, actuation of the lighting system of this example and the display using this is explained.
[0176] After reflecting by direct or the lamp cover 102 (102a-102c), incidence of the light which carried out outgoing radiation from the light source 101 (101a-101c) is carried out to a transparent material 103 (103a-103c). The light which reached the dip reflector on the rear face of a transparent material among the light which the light which carried out incidence to the transparent material 103 (103a-103c) spreads the inside of a transparent material, repeating total reflection, and spreads the inside of a transparent material changes whenever [angle-of-reflection], and separates from them and carries out outgoing radiation of the total reflection conditions on a transparent material front face. After quantity of light distribution and the angular

distribution of the illumination light are equalized with the diffusion plate 105, the light which carried out outgoing radiation from the transparent material 103 (103a-103c) penetrates the phase contrast plate 108, and it carries out incidence to the linearly polarized light separation component 109. As above-mentioned, the linearly polarized light separation component 109 penetrates the linearly polarized light transparency shaft of the polarizing plate 201 by the side of the tooth back of a liquid crystal panel 200, and the linearly polarized light component whose oscillating direction of an electric vector corresponded, and reflects a different polarization component from this.

[0177] Therefore, outgoing radiation is carried out from a transparent material 103 (103a-103c), the diffusion plate 105 and the phase contrast plate 108 are passed, the linearly polarized light transparency shaft of a polarizing plate 201 and the linearly polarized light component whose oscillating direction of an electric vector corresponded penetrate the linearly polarized light separation component 109 among the light which carried out incidence to the linearly polarized light separation component 109, and the linearly polarized light component which intersects perpendicularly with this is reflected. Optical 301C which penetrated the linearly polarized light separation component 109 is irradiated by the liquid crystal panel 200 as it is. On the other hand, it becomes the circular polarization of light (here, the case where it changes with the left-handed circularly-polarized light is explained hereafter) according to an operation of the phase contrast plate 108, the diffusion plate 105 and a transparent material 103 (103a-103c) are passed, it reflects with a reflecting plate 104, and optical 301D reflected with the linearly polarized light separation component 109 faces to the phase contrast plate 108 again. Under the present circumstances, as for the light which the light which passes the diffusion plate 105 and a transparent material 103 did not receive big effect in the condition of polarization, and was further reflected with the reflecting plate 104, the hand of cut of the circular polarization of light serves as the circular polarization of light of reverse.

[0178] For this reason, it reflects with the linearly polarized light separation component 109, and since optical 301D (left-handed circularly-polarized light) which penetrated the phase contrast plate 108 serves as the linearly polarized light which penetrates the linearly polarized light separation component 109 according to that operation in case [of a reflecting plate 104] it becomes the right-handed circularly polarized light and the phase contrast plate 108 is again penetrated in the case of an echo, shortly, it penetrates the linearly polarized light separation component 109, and is irradiated by the liquid crystal panel 200.

[0179] Therefore, after the outgoing radiation light which is the unpolarized light from the light source 101 is efficiently changed into the desired linearly polarized light, it will be irradiated by the liquid crystal panel 200. Here, the desired linearly polarized light means the linearly polarized light which penetrates the polarizing plate 201 by the side of the illumination-light incidence of a liquid crystal panel 200.

[0180] According to image information, the amount of transmitted lights of the illumination light is controlled by the liquid crystal panel 200, and an image is displayed. Under the present circumstances, the light 301C and 301D which carried out incidence to the liquid crystal panel 200 contributes to a display, without absorbing almost with a polarizing plate 201. That is, since it is absorbed with the polarizing plate 201 of a liquid crystal panel 200 and the light which was useless can be used effectively conventionally, a bright and low power display is realizable. The brightness of the screen improved about 49% with the same power consumption to the case where the lighting system which does not have the phase contrast plate 108 and the linearly polarized light separation means 109 actually is used.
[0181] In addition, although it is needless to say, also in this example, the same effectiveness as the above-mentioned example is acquired. namely, -- the case where enlargement (big-screen-izing) is attained by carrying out alignment arrangement of two or more unit lighting systems which consist of the light source, a transparent material, a lamp cover, and a reflecting plate -- a thin light weight -- it is -- and the luminance distribution within a field -- uniform -- high -- the lighting system which carries out outgoing radiation of the brightness light is realizable, it is more bright and the display which can perform the high-definition display with the high homogeneity within a field of brightness can be realized.
[0182] By the way, optical 302B which carried out incidence to the non-opening 206 of a liquid crystal panel 200 among the light irradiated by the liquid crystal panel 200 does not contribute to a display, but reflects and faces to a lighting system 100 in the beginning. In case the light which faced to the lighting system 100 penetrates the linearly polarized light separation component 109 and penetrates the phase contrast plate 108, it turns into the right-handed circularly polarized light in response to the operation. The diffusion plate 105 and a transparent material 103 (103a-103c) are penetrated, it reflects with a reflecting plate 104 (104a-104c), and the light which penetrated the phase contrast plate 108 turns into the left-handed circularly-polarized light. In case optical 302B used as the left-handed circularly-polarized light penetrates the phase contrast plate 108, it becomes the linearly polarized light reflected with the linearly polarized light separation component 109 in response to the operation, and is reflected with the linearly polarized light separation component 109. Optical 302B reflected with the linearly polarized light separation component 109 becomes the right-handed circularly polarized light, in case it becomes the left-handed circularly-polarized light in response to the operation, and the diffusion plate 105 and a transparent material 103 (103a-103c) are again penetrated, in case the phase contrast plate 108 is passed, and it reflects with a reflecting plate 104. In case optical 302B used as the right-handed circularly polarized light penetrates a transparent material 103 (103a-103c) and the diffusion plate 105 again and penetrates the phase contrast plate 108, according to the operation, since it becomes the linearly polarized light which penetrates the linearly polarized light separation

component 109 shortly, it penetrates the linearly polarized light separation component 109, and is irradiated by the liquid crystal panel 200. Since optical 302B which carried out re-incidence to the liquid crystal panel 200 is the linearly polarized light the linearly polarized light transparency shaft of a polarizing plate 201 and whose oscillating direction of an electric vector corresponded, it contributes to a display, without absorbing almost with a polarizing plate 201. That is, since the light which reflected by the non-opening 206 of a liquid crystal panel 200, and was not able to contribute to a display is reusable in the condition that there is no big loss, even if it is a liquid crystal panel with a low numerical aperture, it is effective in a bright display being obtained.

[0183] In addition, although the diffusion plate 105 has been arranged at the tooth back of the phase contrast plate 108 in the above-mentioned explanation, if the location of ******** 105 is between a liquid crystal panel 200 and a transparent material 103 (103a-103c), it will be good anywhere and will not be limited to the above-mentioned example.

[0184] (Example 7) The example of the lighting system of the others which start this invention next, and the display using this is explained using a drawing. drawing 20 shows an example of the lighting system of this invention, and the display which used this -- it is an outline sectional view a part. This example arranges the linearly polarized light separation component 701 between the light source 101 which constitutes the unit lighting system 1000 explained in (the example 4), and the end face of the transparent material 103 by which contiguity arrangement of the light source 101 is carried out, and attaches the same sign to the same part as the above-mentioned example, and detailed explanation is omitted.

[0185] Two or more transparent materials 103 which carried out alignment arrangement like the lighting system which explained the lighting system 100 in (the example 4), Two or more light sources 101 which are arranged, respectively on one side face (end face) of two or more transparent materials 103, and have the luminescence length corresponding to the side-face (end face) die length, Two or more lamp covers 102 arranged, respectively so that the part except the transparent material 103 direction of two or more light sources 101 may be covered, It has two or more reflecting plates 104 arranged through an air space, respectively at the rear face (field of a liquid crystal panel 200 and an opposite hand) of two or more transparent materials 103, and the diffusion plate 105 arranged so that the whole surface may be covered to the front-face (field by the side of liquid crystal panel 200) side of two or more transparent materials 103. In this example, the light source 101 has arranged the linearly polarized light separation component 701 further between the end face of the transparent material 103 by which contiguity arrangement is carried out, and the light source 101.

[0186] That is, a lighting system 100 carries out alignment arrangement of two or more unit lighting systems 1000 which consist of a transparent material 103, the light

source 101 arranged on one side face (end face) of a transparent material 103, a lamp cover 102, a reflecting plate 104 arranged at the rear face of a transparent material 103, and a linearly polarized light separation component 701, and consists of diffusion plates 105 arranged so that the whole surface may be covered to the front-face side.
[0187] In case the unit lighting system 1000 constitutes the transparent material which constitutes this from the tabular transparent body with which the thickness of the end face which a couple faces differs and carries out alignment arrangement of two or more transparent materials, it joins an end face with large thickness, and an end face with small thickness so that the level difference and optical target by the side of a front face may not have a joint. the location where the light source approaches an end face with larger thickness among the end faces which the couple from which the thickness of a transparent material differs faces -- it is -- in addition -- and it arranges in the location used as the rear face of a ****** transparent material. Moreover, it is an end face with the larger thickness among the end faces which the end-face part in which the light source light of a transparent material 103 carries out incidence, i.e., the couple from which the thickness of a transparent material differs, faces, and the linearly polarized light separation component 701 is arranged into the part except the joint of transparent materials. The reflecting plate which is arranged through an air space so that the whole rear-face surface of a transparent material 103 may be covered, has the function to reflect in a transparent material 103 side the light which comes from the direction of a transparent material 103, and has the reflector where the polarization condition of the reflected light is maintained further is used for the reflecting plate 104 of this example. The reflector which maintains the polarization condition described here reflects the linearly polarized light to vertical-incidence light with the linearly polarized light at least, and the circular polarization of light is a reflector which the hand of cut reflects as the circular polarization of light of reverse.
[0188] The thing thing which formed the silver thin film by the sputtering method can be used on the support base material which can use the reflecting plate 104 explained in (the example 4) as a reflecting plate 104, for example, consists of a PET film.
[0189] A transparent material 103 is the same as that of (an example 4), and can use the transparent material explained with reference to drawing 4 - drawing 6 . That is, it is the tabular transparent body with which the thickness of the end face which a couple faces differs, it can change according to the concavo-convex field of a large number which have the detailed inclined plane in_which the direction of the configuration which confines in the interior the light in which thickness carried out incidence from the thick end face by total reflection, and the light which spreads the interior was formed at the rear face (a liquid crystal panel 200 and opposite hand) of a transparent material, or the minute dip reflector constituted by the level difference, and what considered as the configuration which carries out outgoing radiation to a liquid-crystal-panel 200 side can use.

[0190] Under the present circumstances, the transparent body which constitutes a transparent material 103 needs to be directions [target / the below-mentioned reason to / optical]. As the **** transparent bodies [target / optical], glass and the acrylic resin formed with injection molding can be used. Here, since specific gravity is generally larger than acrylic resin, if glass is the same volume, it will become heavy, and since neither processing nor shaping is still as easier as acrylic resin, it is good [glass] to use acrylic resin as a transparent material.
[0191] What formed the alicyclic acrylic resin (trade-name OPUTORETTSU: Hitachi Chemical make) which is the ingredient of low birefringence with injection molding as a transparent material 103 was used especially here. Minute dip reflector 103A on the rear face of a transparent material formed the direction of a major axis so that it might become parallel to the direction of a major axis of the light source 101, and it cost whenever [to surface 103C of a transparent material 103 / average pitch / of minute dip reflector 103A / of P= 200 micrometers /, average height / of h= 10 micrometers /, and average tilt-angle] for theta= 40 degrees.
[0192] Moreover, the transparent material 103 was constituted so that the thickness of the end face 1032 which faces this might become thin continuously to the thickness of the end face 1031 by the side of the light source 101.
[0193] In addition, are low in height h of minute dip reflector 103A in the place near the light source 101. It is made to change continuously so that it may become high in a location distant from the light source 101. Minute dip reflector 101A A pitch P Or change theta continuously with the distance from the light source 101 whenever [tilt-angle]. Or it is good to raise the homogeneity of the light which constitutes the thickness of a transparent material 103, i.e., the distance of surface 103C of a transparent material, and principal plane 103B on the back, so that it may become thin in nonlinear according to the distance from the light source, and carries out outgoing radiation from a transparent material 103.
[0194] The diffusion plate 105 is arranged so that the whole surface may be covered to the front-face (field by the side of liquid crystal panel 200) side of two or more transparent materials 103 which constitute two or more unit lighting systems 1000.
[0195] The diffusion plate 105 changes the angular distribution of the light which carried out outgoing radiation from the transparent material 103, and luminance distribution, and has the function which raises the angular distribution of the illumination light irradiated to a liquid crystal panel 200, and the homogeneity of the luminance distribution within a field.
[0196] Especially in this example, what has the function which diffuses the light which carried out incidence where abbreviation maintenance of the polarization condition is carried out is used. What is necessary is just to use the diffusion plate explained in (the example 4) as such a diffusion plate. For example, a **** spherical transparence [target / which consists of glass or resin on a triacetyl cellulose film / optical] bead can be arranged in in the shape of a field, and what was fixed can be used with acrylic

transparence adhesion resin.
[0197] The more it enlarges distance on the diffusion plate 105 and the front face of a transparent material, the more it becomes impossible in addition, to check change of the luminance distribution within a field of the illumination light for the joint of a unit lighting system by looking. Although specifically based also on the diffusibility of the diffusion plate 105, if it is a realistic diffusion plate, it will become impossible for change of the luminance distribution within a field of the illumination light in the joint which joined 0.1mm – about 15mm, then a unit lighting system to check the distance of the diffusion plate 105 and transparent material 103 front face by looking, and the illumination light with the high homogeneity of the luminance distribution within a field will be obtained. Moreover, although it is not necessary to necessarily arrange if the angular distribution of the illumination light and the homogeneity of the luminance distribution within a field are high even if the diffusion plate 105 does not have this, it is usually needed.
[0198] The linearly polarized light separation component 701 penetrates a specific linearly polarized light component among the light which carried out incidence to this, and a different polarization component from this has the function to reflect. Various the configuration is [the birefringence reflective mold polarization film which carried out two or more layer laminating of the birefringence high polymer film from which it is consider, for example, a publication differs in international disclosure number:WO 95/27919 of international application by turns, and] SID92 Digest p427. The vertical angle of a publication can use the tabular thing which formed in a two-sheet pile and its superposition section the polarization separation side according the prism array which are 90 abbreviation to a dielectric multilayer.
[0199] Moreover, in addition to this, a cholesteric-liquid-crystal layer and the thing which carried out laminating arrangement of the phase contrast plate can also be used as a linearly polarized light separation component 701. In this case, laminating arrangement is carried out toward the end face of a transparent material 103 at the order of a cholesteric-liquid-crystal layer and a phase contrast plate from a light source 101 side.
[0200] As above-mentioned [a cholesteric-liquid-crystal layer], the circular polarization of light of one hand of cut is reflected among the light which carried out incidence to this, and another side shows the selective reflection of penetrating. Since it corresponds white, selective reflection happens throughout a visible wavelength region, or in order to make it selective reflection happen in the wavelength of the bright line spectrum corresponding to the three primary colors of the light source 101, the laminating of two or more cholesteric-liquid-crystal layers from which a pitch differs is carried out, and they are used. Or it is good to use the cholesteric-liquid-crystal layer to which a pitch which is indicated by Asia Display95 Digest p735 was changed continuously.
[0201] A phase contrast plate changes into the linearly polarized light the circular

polarization of light which penetrated the cholesteric-liquid-crystal layer, and what functions as a quarter-wave length plate in a visible wavelength region is used. The extended high polymer film which has high transmission in a visible wavelength region as a phase contrast plate, for example, polyvinyl alcohol, a polycarbonate, Pori Sall John, polystyrene, polyarylate, etc. can be used. In addition, the liquid crystal layer which arranged a mica, Xtal, or a molecule shaft with the one direction, and carried out orientation can be used.

[0202] The transparency shaft of the linearly polarized light of the linearly polarized light separation component 701 is arranged so that the linearly polarized light which penetrated this may serve as an s-polarized light component to the minute dip reflector formed in the rear face of a transparent material 103. That is, in drawing 20 , if the longitudinal direction of the triangular groove which constitutes the minute dip reflector of transparent material 103 rear face is the direction of a space perpendicular, it will arrange so that the transparency shaft of the linearly polarized light of the linearly polarized light separation component 701 may also serve as the direction of a space perpendicular.

[0203] Next, it explains paying attention to the 1 unit lighting system 100 which constitutes this lighting system, referring to drawing 20 for actuation of the lighting system of this example.

[0204] After reflecting by direct or the lamp cover 102, incidence of the light 3000 which carried out outgoing radiation from the light source 101 is carried out to the linearly polarized light separation component 701. Under the present circumstances, since it is unpolarized light, the outgoing radiation light 3000 from the light source 101 penetrates the specific linearly polarized light component which is equivalent to abbreviation one half among the light which carried out incidence to the linearly polarized light separation component 701, and reflects a different polarization component from this.

[0205] It reflects by the light source 101 or the lamp cover 102, and incidence of the light 3002 reflected with the linearly polarized light separation component 701 is again carried out to the linearly polarized light separation component 701. The light source 101 or the specific linearly polarized light component in a lamp cover 102 which is equivalent to the abbreviation one half since change or polarization is solved by the polarization condition in the case of an echo penetrates the light which carried out re-incidence to the linearly polarized light separation component 701, and a different polarization component from this is reflected again. While repeating this actuation, it becomes the linearly polarized light of the specification of the light which carried out outgoing radiation about 65% from the light source 101, and the linearly polarized light separation component 701 is passed.

[0206] Incidence of the light 3001 which penetrated the linearly polarized light separation component 701 is carried out to a transparent material 103. The light which resulted in minute dip reflector 103A of transparent material 103 rear face

among the light which the light 3001 which carried out incidence to the transparent material 103 spreads the inside of a transparent material 103, repeating total reflection, and spreads the inside of a transparent material 103 changes whenever [angle-of-reflection], and separates from them and carries out outgoing radiation of the total reflection conditions by transparent material surface 103C.

[0207] Under the present circumstances, it is s-polarized light or light with many s-polarized light components to minute dip reflector 103A of transparent material 103 rear face, and since a polarization condition is maintained, the light which spreads the inside of a transparent material 103 further since the light which carries out incidence to a transparent material 103 is the light which penetrated the linearly polarized light separation component 701 and that most is directions, such as abbreviation, optically for a transparent material 103 is s-polarized light or light with many s-polarized light components to minute dip reflector 103A.

[0208] If the light of the light which carries out incidence aslant here to the reflector which generally consists of a dielectric or a conductor is the linearly polarized light of s-polarized light or p-polarized light to a reflector, the reflected light is the same linearly polarized light as incident light.

[0209] Therefore, the inside of a transparent material 103 is spread, and among the light which results in minute dip reflector 103A, to a minute dip reflector, the light which is s-polarized light changes the travelling direction of light with s-polarized light, and carries out outgoing radiation from a transparent material 103.

[0210] That is, as for the light which carries out outgoing radiation, the illumination light of light with many s-polarized light components, i.e., the abbreviation linearly polarized light with the oscillating direction of an electric vector parallel to the longitudinal direction of minute inclined plane 103A of transparent material 103 rear face, is obtained from a transparent material 103 to dip reflector 103A of transparent material 103 rear face. Here, the effectiveness of the following [making light which spreads the inside of a transparent material into the linearly polarized light which turns into s-polarized light to minute dip reflector 103A] is acquired.

[0211] Drawing 21 is drawing having shown whenever [when not forming an exceptional reflector in minute dip reflector 103A / optical incident angle], and the relation of a reflection factor about p-polarized light and s-polarized light. That is, the case where the echo by minute dip reflector 103A arises according to the refractive-index difference of a transparent material and air is shown.

[0212] A passage clearer than drawing 21 , to p-polarized light, the reflection factor of s-polarized light is high, for example, the reflection factor of s-polarized light becomes [whenever / incident angle] high about 30% at 40 degrees whenever [incident angle] 10% to the reflection factor of p-polarized light by 30 degrees. That is, it reflects by minute dip reflector 103A, and since the illumination light which carries out outgoing radiation from a transparent material has the high reflection factor of s-polarized light, it is making into s-polarized light light which carries out

incidence to a transparent material from the start, and the more efficient specific linearly polarized light is acquired.

[0213] The light which carried out outgoing radiation from the transparent material 103 is irradiated by the liquid crystal panel 200 after quantity of light distribution and the angular distribution of the illumination light are equalized with the diffusion plate 105. Under the present circumstances, in order that the diffusion plate 105 may maintain a polarization condition, the predetermined linearly polarized light is irradiated by the liquid crystal panel 200.

[0214] In addition, in the lighting system of this example, distance to the width of face of a transparent material, i.e., the light source side edge side of a transparent material, and this and the end face which counters cannot be depended on the magnitude of a liquid crystal panel display, but can be set up short. If the width of face of a transparent material becomes short, the propagation distance of the light which spreads the interior of a transparent material will become short. For this reason, since propagation distance of light will be short made if it is the lighting system of this invention even when the transparent body which has the refractive-index anisotropy of a minute amount like acrylic resin is used as a transparent material, change of a polarization condition ends small and the lighting system which carries out outgoing radiation of the illumination light with many predetermined linearly polarized light components efficiently can be realized.

[0215] Next, a liquid crystal panel 200 is explained. With the lighting system of this example, the illumination light with many linearly polarized light components which have the oscillating direction of an electric vector with the oscillating direction of an electric vector parallel to the longitudinal direction of minute dip reflector 103A (triangular groove to constitute) of transparent material 103 rear face is obtained as above-mentioned. Therefore, in case a lighting system is constituted, the longitudinal direction of the light source 101 is arranged in the direction parallel to the screen longitudinal direction of a liquid crystal panel 200, and if it constitutes so that it may become parallel [the longitudinal direction of the triangular groove which constitutes minute dip reflector 103A of transparent material 103 rear face] to this, the illumination light from a lighting system will turn into the linearly polarized light which has the oscillating direction in the direction parallel to a screen longitudinal direction.

[0216] TN liquid crystal panel can be used like the above-mentioned example as a liquid crystal panel 200. However, generally, with TN liquid crystal panel, in order to acquire the dipleurogenesis of an angle of visibility, to a screen longitudinal direction, 45 degrees (or 135 degrees) of transparency shafts of the linearly polarized light of a polarizing plate 201 and a polarizing plate 205 are leaned, and they are arranged. For this reason, even if it uses the lighting system 100 which carries out outgoing radiation of the specific linearly polarized light, i.e., the linearly polarized light which has the oscillating direction in the direction parallel to a screen longitudinal direction, with much trouble, the illumination light cannot use efficiently.

[0217] Therefore, in this example, even if it makes the transparency shaft of the linearly polarized light in agreement [a polarizing plate 201] with a screen longitudinal direction, it is required for an angle of visibility etc. to use the display mode which does not have an adverse effect. As a liquid crystal panel using such a display mode, the IPS (In Plane Switching) liquid crystal panel which realizes orientation division with the character electrode of **, and a MVA (Multi-domainVertical Aligned) liquid crystal panel can be used.

[0218] Although the case where an IPS liquid crystal panel is used as a liquid crystal panel 200 is hereafter explained by this example, referring to drawing 20 and drawing 22 , this invention is not limited to this.

[0219] Drawing 22 is the front view showing the 1-pixel configuration of the liquid crystal panel 200 of this example. The common electrode 2003 and the scan signal electrode 2004 with which 1 pixel of a liquid crystal panel 200 consists of aluminum alloys with which the alumina film formed on the transparence glass substrate 202 was covered, The video-signal electrode 2001 and the pixel electrode 2002 which consist of aluminum/Cr formed through the gate dielectric film which consists of SiN which is not illustrated in these upper layers, It has TFT (Thin Film Transistor)2006 as a switching element formed with these electrodes, amorphous Si (a-Si) film, n mold a-Si film which is not illustrated, etc.

[0220] Furthermore the protective layer which consists of SiN is formed in these upper layers, and the liquid crystal layer 208 is formed through the orientation film on it.

[0221] Moreover, the pixel electrode 2002 forms overlap and retention volume in part with the common electrode 2003.

[0222] The common electrode 2003 and the pixel electrode 2002 have become the form, i.e., a zigzag mold, where the character type of ** was connected, dividing 1 pixel into four fields and keeping the gap of abbreviation regularity mutual. alpha costs whenever [angle-of-inclination / of the character of ** to the liquid crystal panel 200 display up down one of the common electrode 2003 and the pixel electrode 2002] for +10 degrees and -10 degrees.

[0223] As liquid crystal which constitutes the liquid crystal layer 208, here prescribed the direction of a liquid crystal molecule major axis to the orientation film formed on two transparence glass substrates 202,204 by performing orientation processing using the liquid crystal which has a forward dielectric anisotropy. The direction of liquid crystal orientation of the liquid crystal layer 208 is the so-called homogeneous orientation which does not have a twist between two transparence glass substrates 202,204, and it carried out orientation of the direction of a liquid crystal molecule major axis so that it might intersect perpendicularly with a liquid crystal panel 200 display longitudinal direction.

[0224] Drawing 23 is drawing showing the conditions of each part material at the time of being based on a liquid crystal panel 200 display longitudinal direction, and shows

the direction of orientation of the transparency shaft of the linearly polarized light of the polarizing plate 205 of this example, and a polarizing plate 201, and the liquid crystal molecule major axis of the liquid crystal layer 208, and the longitudinal direction of minute dip reflector 103A (triangular groove to constitute) of transparent material 103 rear face.

[0225] As a graphic display, with the display of this example, the transparency shaft of the linearly polarized light of the polarizing plate 205 by the side of the observer of a liquid crystal panel 200 is arranged so that a screen longitudinal direction and 90 degrees may be accomplished and the direction of the liquid crystal molecule major axis of the liquid crystal layer 208 may also accomplish a screen longitudinal direction and 90 degrees. The transparency shaft of the linearly polarized light of the polarizing plate 201 by the side of the illumination-light incidence of a liquid crystal panel 200 was considered as a screen longitudinal direction and parallel, and it was constituted so that it might become parallel [the longitudinal direction of minute dip reflector 103A of transparent material 103 rear face which constitutes a lighting system] to a screen longitudinal direction.

[0226] By this configuration, the so-called Nor Marie Close's display property that it will serve as clear display if the liquid crystal panel 200 of this example serves as a dark display and applied voltage to the liquid crystal layer 208 is made high when an electrical potential difference is not impressed in the liquid crystal layer 208 is acquired.

[0227] Here, an electrode, a switching element, etc. exist in a liquid crystal panel 200, and these parts serve as the non-display section (non-opening 206), and do not contribute to the brightness of an image. Although the non-[these] opening 206 does not contribute to the brightness of an image, since most is a metal electrode, light is reflected. The liquid crystal panel of this example raised the reflection factor of the light in the non-opening 206 by using aluminum (aluminum) alloy other than Cr (chromium) alloy. It is a rate of surface ratio at the time of seeing from the liquid crystal panel 200 tooth-back side of Cr and aluminum in the liquid crystal panel 200 specifically applied to this example Cr:aluminum=1:1.4 It carried out. 54% of reflection factors at the time of using only Cr as a metal electrode was able to be raised to 74% of reflection factors by carrying out like this.

[0228] Next, actuation of this display is explained, referring to drawing 20 .

[0229] In the lighting system 100 of this example, as above-mentioned, it becomes the linearly polarized light of the specification of the outgoing radiation light from the light source 101 which is unpolarized light about 65%, the linearly polarized light separation component 701 is passed, and incidence is carried out to a transparent material 103. The light which the light which carried out incidence to the transparent material 103 spread the inside of a transparent material, repeating total reflection, among those resulted in dip reflector 103A of transparent material 103 rear face changes whenever [angle-of-reflection], and separates from them and carries out

outgoing radiation of the total reflection conditions by transparent material surface 103C. As for the light which carried out outgoing radiation, light with many s-polarized light components, i.e., the illumination light with many linearly polarized light components with the oscillating direction of an electric vector parallel to the longitudinal direction of minute inclined plane 103A of transparent material 103 rear face, is obtained from a transparent material 103 to minute dip reflector 103A of transparent material 103 rear face.

[0230] The light which carried out outgoing radiation from the transparent material 103 is irradiated by the liquid crystal panel 200 after quantity of light distribution and the angular distribution of the illumination light are equalized with the diffusion plate 105. Under the present circumstances, in order that the diffusion plate 105 may maintain a polarization condition, the polarization condition of the outgoing radiation light from a transparent material 103 reaches a liquid crystal panel 200, while it had been maintained. The amount of transmitted lights is controlled according to image information, and, as for the light irradiated by the liquid crystal panel 200, an image is displayed on an observer.

[0231] Under the present circumstances, since it constituted so that it might become parallel [the transparency shaft of the linearly polarized light of the polarizing plate 201 by the side of the illumination-light incidence of a liquid crystal panel 200] to the longitudinal direction of minute dip reflector 103A of transparent material 103 rear face which constitutes a lighting system, most illumination light contributes to a display, without absorbing almost with the polarizing plate 201 by the side of the lighting system of a liquid crystal panel 200.

[0232] That is, after being efficiently changed into the desired linearly polarized light, the outgoing radiation light which is the unpolarized light from the light source 101 is irradiated by the liquid crystal panel 200, and it contributes to a display, without absorbing almost with a polarizing plate 201. Therefore, since it is absorbed with the polarizing plate 201 of a liquid crystal panel 200 and the light which was useless can be used effectively conventionally, a bright and low power display is realizable.

[0233] In addition, the non-openings 206, such as an electrode and a switching element, exist in a liquid crystal panel 200 as above-mentioned. Although the non-[these] opening 206 does not contribute to the brightness of an image, since most is a metal electrode, light is reflected.

[0234] Therefore, although optical 30001A which carried out incidence to the opening 207 among the light irradiated by the liquid crystal panel 200 is used for a display as it is, optical 3001B which carried out incidence to the non-opening 206 of a liquid crystal panel 200 does not contribute to a display, but reflects and returns to a lighting system 100.

[0235] Optical 3001B which returned to the lighting system 100 penetrates the diffusion plate 105 and a transparent material 103, it reflects with a reflecting plate 104, and it penetrates a transparent material 103 and the diffusion plate 105 again,

and is irradiated by the liquid crystal panel 200. Under the present circumstances, at this example, by transparency of the diffusion plate 105 and a transparent material 103, and echo with a reflecting plate 104, the polarization condition of light is maintained and does not change a lot. For this reason, since optical 3001B again irradiated by the liquid crystal panel 200 is maintaining mostly the polarization condition when being first reflected by the non-opening 206 of a liquid crystal panel 200, it can be contributed to a display, without absorbing almost with a polarizing plate 201. Namely, in the display of this example, since the light which was shaded by the non-opening 206 of a liquid crystal panel 200, and was not able to contribute to a display is reusable in the condition that there is no big loss, conventionally, even if it is a liquid crystal panel with a low numerical aperture, it is effective in a bright display being obtained.

[0236] Here, although it has the function to change into the desired linearly polarized light the light source light which is unpolarized light like this example, in (an example 5) and (example 6) the explained lighting system, after the return light from the non-opening 206 of a liquid crystal panel 200 penetrates 2 ****s of two echoes with the reflecting plate 104 of transparent material 103 rear face, a transparent material 103, and the diffusion plates 105, it is irradiated by the liquid crystal panel.

[0237] On the other hand, in this example, while having the function to change into the desired linearly polarized light the light source light which is unpolarized light, after reflecting once with the reflecting plate 104 of transparent material 103 rear face, the return light from the non-opening 206 of a liquid crystal panel 200 only penetrated 1 **** of a transparent material 103 and the diffusion plates 105, and is again irradiated by the liquid crystal panel 200.

[0238] For this reason, loss with a reflecting plate 104, and the transparent material 103 and the diffusion plate 105 of return light from the non-opening 206 and the turbulence of a polarization condition become small, and can reuse the return light from the non-opening 206 more efficiently.

[0239] That is, since the effectiveness shows up more notably in the lighting system of this example, and the display using this when what has a numerical aperture low as a liquid crystal panel is used, combination with liquid crystal panels with a comparatively low numerical aperture, such as an IPS liquid crystal panel, or the liquid crystal panel which became a low numerical aperture by highly minute-ization is suitable as a liquid crystal panel.

[0240] In addition, although Cr alloy and aluminum alloy were used together as a metal electrode in this example, this invention is not limited to this. That is, it is desirable to stop the optical loss by the optical absorption in the non-opening 206 to the minimum, as the tooth-back side of a liquid crystal panel 200 uses the metal with high reflection factors, such as aluminum and Ag, of an electrode, or forms the reflector by a dielectric multilayer etc. in the liquid crystal panel tooth-back side of the non-opening 206 ideally and the light which carries out incidence to the non-opening 206 is

reflected in a lighting-system side with a high reflection factor. [at least]
[0241] By the way, the linearly polarized light separation component of a liquid crystal panel display and the area more than comparable was required of (the example 6). On the other hand, the linearly polarized light separation component used by this example compares it, although the specific end face of a transparent material is depended also on the configuration of a transparent material (example 6), since only a part for a wrap is required, and the operating area decreases with 1 / 5 - 1/20. Since a linearly polarized light separation component is generally expensive, it is effective in the ability to carry out [low cost]-izing of the equipment by reducing the amount of the linearly polarized light separation component used.
[0242] Moreover, although it is not necessary to state, also in this example, the same effectiveness as the above-mentioned example is acquired. namely, -- the case where enlargement (big-screen-izing) is attained by carrying out two or more alignment arrangement of the unit lighting system which consists of the light source, a transparent material, a lamp cover, and a reflecting plate -- a thin shape -- it is -- and the luminance distribution within a field -- uniform -- high -- the lighting system which carries out outgoing radiation of the brightness light is realizable, it is more bright and the display which can perform the high-definition display with the high homogeneity within a field of brightness can be realized.
[0243] (Example 8) The example of the lighting system of the others which start this invention next, and the display using this is explained using a drawing. drawing 24 shows an example of the lighting system of this invention, and the display which used this -- it is an outline sectional view a part.
[0244] This example arranges optical convergence section 103M in the lighting system explained in (the example 7) between the light source 101 and the linearly polarized light separation component 701 arranged to the end face of the transparent material 103 by which contiguity arrangement of this is carried out, the same sign is attached to the same part as the above-mentioned example, and detailed explanation is omitted.
[0245] Optical convergence section 103M are a means for having the function to converge the divergence light from the light source 101, changing light source light into the condition more near parallel light, and carrying out incidence to the linearly polarized light separation component 701.
[0246] Optical convergence section 103M are between the light source 101 and the linearly polarized light separation component 701, and are arranged in the location used as the rear face of a ****** transparent material. Optical convergence section 103M consist of the transparent bodies, such as acrylic resin and glass, and have become the taper configuration to which the cross section becomes large toward a transparent material 103 side from the light source 101 side.
[0247] Moreover, in the field except the end face by the side of the optical convergence section 103 linearly polarized light separation component 701, a

reflecting plate 1041 is arranged through an air space with the end face by the side of the light source of M.
[0248] Since the design of optical convergence section 103M is already known well, the detail is omitted, but probably, the end face by the side of the light source of optical convergence section 103M should just be taken as about 1.2 to 1.5 times [of the tube diameter of the light source 101] thickness, in order to make incidence effectiveness of light source light high.
[0249] Next, it explains paying attention to the 1 unit lighting system 100 which constitutes this lighting system, referring to drawing 24 for actuation of the lighting system of this example.
[0250] After reflecting by direct or the lamp cover 102, incidence of the light 3000 which carried out outgoing radiation from the light source 101 is carried out to optical convergence section 103M. It is completed by echo in the front face of optical convergence section 103M, a rear face, and a side face, and incidence of the light which carried out incidence to optical convergence section 103M is carried out to the linearly polarized light separation component 701.
[0251] Here, the linearly polarized light separation component 701 penetrates a specific linearly polarized light component among the light which carried out incidence to this, and a different polarization component from this has the function to reflect. The birefringence reflective mold polarization film which carried out two or more layer laminating of the birefringence high polymer film from which a publication differs to international disclosure number:WO 95/27919 of international application by turns as a linearly polarized light separation component 701 as above-mentioned, SID92 Digest p427 The thing which formed in a two-sheet pile and its superposition section the polarization separation side according the prism array whose vertical angles of a publication are 90 abbreviation to a dielectric multilayer or a cholesteric-liquid-crystal layer, and the thing which carried out laminating arrangement of the phase contrast plate can be used.
[0252] Although each of these achieves a function efficiently to the light which carries out incidence at a vertical or vertically near include angle, to the light which carries out incidence, a function falls from across.
[0253] In this example, the rate of the increase of the rate of the light which carries out incidence at right angles to the linearly polarized light separation component 701 by converging the light which carried out outgoing radiation from the light source by optical convergence section 103M, or the light on which it carries out and the linearly polarized light separation component 701 functions effectively is raised.
[0254] After converging by optical convergence section 103M, incidence of the outgoing radiation light 3000 from the light source 101 which is unpolarized light is carried out to the linearly polarized light separation component 701. Since the light which carried out incidence to the linearly polarized light separation component 701 has many rates of the light which carries out incidence at right angles to the linearly

polarized light separation component 701, it penetrates as an efficient specific linearly polarized light component, and a different polarization component from this is reflected.

[0255] It reflects by the reflecting plate 1041 arranged on the outside of optical convergence section 103M or the light source 101, or the lamp cover 102, and the light 3004 reflected with the linearly polarized light separation component 701 goes to the linearly polarized light separation component 701 again.

[0256] The light which carries out re-incidence to the linearly polarized light separation component 701 penetrates a reflecting plate 1041, the light source 101, or the specific linearly polarized light component in a lamp cover 102 that is equivalent to the abbreviation one half since change or polarization is solved by the polarization condition in the case of an echo, and a different polarization component from this is reflected again. While repeating this actuation, it becomes the linearly polarized light of the specification of the unpolarized light which carried out outgoing radiation about 70% from the light source 101, and the linearly polarized light separation component 701 is passed.

[0257] Incidence of the light 3003 which penetrated the linearly polarized light separation component 701 is carried out to a transparent material 103. The light which resulted in minute dip reflector 103A of transparent material 103 rear face among the light which the light 3003 which carried out incidence to the transparent material 103 spreads the inside of a transparent material 103, repeating total reflection, and spreads the inside of a transparent material 103 changes whenever [angle-of-reflection], and separates from them and carries out outgoing radiation of the total reflection conditions by transparent material surface 103C.

[0258] Under the present circumstances, since the light which spreads the inside of a transparent material 103 is the light which penetrated the linearly polarized light separation component 701 To dip reflector 103A of transparent material 103 rear face, the most is s-polarized light or light with many s-polarized light components, and the light which carries out outgoing radiation from a transparent material 103 also receives dip reflector 103A of transparent material 103 rear face. It becomes light with many s-polarized light components, i.e., light with many linearly polarized light components with the oscillating direction of an electric vector parallel to the longitudinal direction of minute inclined plane 103A of transparent material 103 rear face.

[0259] Next, actuation of this display is explained, referring to drawing 24 .

[0260] In the lighting system 100 of this example, as above-mentioned, it becomes the linearly polarized light of the specification of the outgoing radiation light from the light source 101 which is unpolarized light about 70%, the linearly polarized light separation component 701 is passed, and incidence is carried out to a transparent material 103. The light which the light which carried out incidence to the transparent material 103 spread the inside of a transparent material, repeating total reflection,

among those resulted in dip reflector 103A of transparent material 103 rear face changes whenever [angle-of-reflection], and separates from them and carries out outgoing radiation of the total reflection conditions by transparent material surface 103C. To minute dip reflector 103A of transparent material 103 rear face, since it is light with many s-polarized light components, as for the light which carried out outgoing radiation from the transparent material 103, the illumination light with many linearly polarized light components with the oscillating direction of an electric vector parallel to the longitudinal direction of minute inclined plane 103A of transparent material 103 rear face is obtained. The light which carried out outgoing radiation from the transparent material 103 is irradiated by the liquid crystal panel 200 after quantity of light distribution and the angular distribution of the illumination light are equalized with the diffusion plate 105. Under the present circumstances, in order that the diffusion plate 105 may maintain a polarization condition, the polarization condition of the outgoing radiation light from a transparent material 103 reaches a liquid crystal panel 200, while it had been maintained. The amount of transmitted lights is controlled according to image information, and, as for the light irradiated by the liquid crystal panel 200, an image is displayed on an observer.

[0261] Under the present circumstances, since it constituted so that it might become parallel [the transparency shaft of the linearly polarized light of the polarizing plate 201 by the side of the lighting system of a liquid crystal panel 200] to the longitudinal direction of minute dip reflector 103A of transparent material 103 rear face which constitutes a lighting system, most illumination light contributes to a display, without absorbing almost with the polarizing plate 201 by the side of the lighting system of a liquid crystal panel 200.

[0262] That is, after being efficiently changed into the desired linearly polarized light, the outgoing radiation light which is the unpolarized light from the light source 101 is irradiated by the liquid crystal panel 200, and it contributes to a display, without absorbing almost with a polarizing plate 201. Therefore, since it is absorbed with the polarizing plate 201 of a liquid crystal panel 200 and the light which was useless can be used effectively conventionally, a bright and low power display is realizable.

[0263] In addition, although optical 3003A which carried out incidence to the opening 207 among the light irradiated by the liquid crystal panel 200 is used for a display as it is, optical 3003B which carried out incidence to the non-opening 206 of a liquid crystal panel 200 does not contribute to a display, but reflects and returns to a lighting system 100.

[0264] Optical 3003B which returned to the lighting system 100 penetrates the diffusion plate 105 and a transparent material 103, it reflects with a reflecting plate 104, and it penetrates a transparent material 103 and the diffusion plate 105 again, and is irradiated by the liquid crystal panel 200. Under the present circumstances, at this example, by transparency of the diffusion plate 105 and a transparent material 103, and echo with a reflecting plate 104, the polarization condition of light is

maintained and does not change a lot. For this reason, since optical 3003B again irradiated by the liquid crystal panel 200 is maintaining mostly the polarization condition when being first reflected by the non-opening 206 of a liquid crystal panel 200, it can be contributed to a display, without absorbing almost with a polarizing plate 201. Namely, in the display of this example, since the light which was shaded by the non-opening 206 of a liquid crystal panel 200, and was not able to contribute to a display is reusable in the condition that there is no big loss, conventionally, even if it is a liquid crystal panel with a low numerical aperture, it is effective in a bright display being obtained.

[0265] While having the function to change into the desired linearly polarized light the light source light which is unpolarized light also in this example, after reflecting once with the reflecting plate 104 of transparent material 103 rear face, the return light from the non-opening 206 of a liquid crystal panel 200 only penetrated 1 **** of a transparent material 103 and the diffusion plates 105, and is again irradiated by the liquid crystal panel 200. For this reason, absorption with a reflecting plate 104, and the transparent material 103 and the diffusion plate 105 of return light from the non-opening 206 and turbulence of a polarization condition are small, and can reuse the return light from the non-opening 206 more efficiently.

[0266] Therefore, since the effectiveness shows up more notably in the lighting system of this example, and the display using this when what has a numerical aperture low as a liquid crystal panel is used, combination with liquid crystal panels with a comparatively low numerical aperture, such as an IPS liquid crystal panel, or the liquid crystal panel which became a low numerical aperture by highly minute-ization is suitable as a liquid crystal panel.

[0267] Moreover, especially in this example, since the optical convergence section was prepared between the light source and a transparent material, the following effectiveness is acquired. That is, since the part with the high brightness near the light source and the part which carries out outgoing radiation of the illumination light contributed to the display of a liquid crystal panel are separated by the optical convergence section, the homogeneity of the luminance distribution within a field of the illumination light from a unit lighting system becomes higher.

[0268] Furthermore, since the function of a linearly polarized light separation component is raised and the lighting system which it is more efficient and carries out outgoing radiation of the predetermined linearly polarized light is realizable by converging the light which carries out outgoing radiation from the light source and which carries out incidence to a linearly polarized light separation component by the optical convergence section, the display of low place expense power can be realized more brightly.

[0269] (Example 9) The example of the lighting system of the others which start this invention next, and the display using this is explained using a drawing. drawing 25 shows an example of the lighting system of this invention, and the display which used

this -- it is an outline sectional view a part.
[0270] The light source arranged near the transparent material 103 in the lighting system which explained this example in (the example 7), The lamp cover arranged so that the light source may be covered, and LED501 in which plurality carried out alignment arrangement instead of the linearly polarized light separation component 701 arranged to the end face of a transparent material 103 (Light Emitting Diodes), The outgoing radiation light from LED501 is converged, a polarization conversion means 510 to change the outgoing radiation light from LED501 into the predetermined linearly polarized light is arranged, the same sign is attached to the same part as the above-mentioned example, and detailed explanation is abbreviated to the parallel-ized lens 502.
[0271] Two or more transparent materials 103 in which the lighting system 100 carried out alignment arrangement, and two or more reflecting plates 104 arranged through an air space at the rear face (field of a liquid crystal panel 200 and an opposite hand) of two or more transparent materials 103, LED501 in which has the diffusion plate 105 arranged so that the whole surface may be covered to the front-face (field by the side of liquid crystal panel 200) side of two or more transparent materials 103, and plurality carried out alignment arrangement further in the end side of a transparent material 103, The lens 502 which parallel-izes outgoing radiation light from LED501, and a polarization conversion means 510 to change the outgoing radiation light from LED501 into the predetermined linearly polarized light are arranged.
[0272] drawing 26 indicates the outline configuration of a polarization conversion means 510 to change the outgoing radiation light from LED501 into the predetermined linearly polarized light to be the lens 502 which parallel-izes outgoing radiation light from LED501 and LED501 of the plurality when seeing a lighting system from a liquid crystal panel side which carried out alignment arrangement -- it is a sectional view a part.
[0273] In the lighting system of this example, LED of white luminescence is used as the light source.
[0274] As LED of white luminescence, a YAG (yttrium aluminum garnet) system fluorescent substance can be applied to the front face of a GaN system blue luminescence LED chip, the thing which blue luminescence and the fluorescence generated by blue glow are mixed, and serves as the white light, or the blue luminescence LED which made ZnxCd1-xS the ZnSe substrate at the barrier layer can be formed, and what blue luminescence and the fluorescence of the yellow generated in a ZnSe substrate by blue glow are mixed, and serves as the white light can be used.
[0275] or red and the luminescent color of three monochrome luminescence LED components which emit light green and blue -- being mixed -- what realized the white light can be used.

[0276] A lens 502 converges the diffused light which carries out outgoing radiation from LED501, has the function which parallel-izes and arranges it to two or more LED501 corresponding to 1 to 1.
[0277] In addition, since there are some LED lamps equipped with the commercial transparence lens from which outgoing radiation light with high parallelism with strong namely, directivity is obtained, this may be used as what unified LED501 and a lens 502.
[0278] Specifically, name-of-article NSPW500BS (Nichia Chemical Industries make) etc. can be used. In this case, outgoing radiation light with the high directivity whose half power angle is about **10 degrees is obtained.
[0279] The polarization conversion means 510 consists of a polarization separation prism array 509 and a phase contrast plate 504 which arranges the polarization condition of the light which carries out outgoing radiation from the polarization separation prism array 509.
[0280] A cross-section configuration arranges by turns two or more reflectors 505 which reflect in the direction as the polarization separation side 503 which separates the light which carried out outgoing radiation into two kinds of linearly polarized lights the linearly polarized lights and the oscillating direction of an electric vector cross at right angles mutually by an echo and transparency from LED501, and the direction of the light which penetrated the polarization separation side 503 for the light reflected in respect of [503] polarization separation a polarization separation prism array 509 is the same in a direction through the translucency member 506 of the shape of a column of a parallelogram.
[0281] To the emission spectrum of the light source, the translucency member 506 is transparent and consists of an ingredient without birefringence, for example, the ** material of BK-7 grade, acrylic resin, etc. The translucency member 506 is the transparent body of the shape of a column which is the parallelogram the cross-section configuration of whose is 45 degrees of interior angles, an appearance tabular by carrying out sequential junction of this is formed, and the polarization separation side 503 and a reflector 505 are formed in the junction interface of the translucency member 506 by turns.
[0282] The dielectric multilayer which formed the polarization separation side 503 in the translucency member 506, or the international disclosure number of international application: What is necessary is just to realize the birefringence reflective mold polarization film which carried out two or more layer laminating of the different birefringence high polymer film which is indicated by WO 95/27919 by turns by putting between the junction interface of the translucency member 506. The polarization separation side 503 of this example penetrates the linearly polarized light which turns into p-polarized light to the polarization separation side 503, and it constitutes the linearly polarized light used as s-polarized light so that it may reflect.
[0283] A reflector 505 reflects the light reflected in respect of [503] polarization

separation in the same direction as the light which penetrated the polarization separation side 503, and should just realize it according to specular reflection sides, such as metal thin films, such as the same dielectric multilayer as the polarization separation side 503, or aluminum, Ag.

[0284] The phase contrast plate 504 has the function to arrange the light which carries out outgoing radiation from the polarization separation prism array 509 with the linearly polarized light which turns into s-polarized light to minute dip reflector 103A of transparent material 103 rear face. In this example, the light which the light which penetrated the polarization separation side 503 of the polarization separation prism array 509 is s-polarized light, reflected in respect of [503] polarization separation to minute dip reflector 103A of transparent material 103 rear face, and was reflected further in the reflector 504 is p-polarized light to minute dip reflector 103A of transparent material 103 rear face.

[0285] For this reason, it arranges using what has the function to change into s-polarized light the linearly polarized light which is p-polarized light as a phase contrast plate 504 to minute dip reflector 103A of transparent material 103 rear face into the part which the light reflected among the optical outgoing radiation sides of the polarization separation prism array 509 in the polarization separation side 503 and the reflector 505 passes.

[0286] That is, what functions as 1/2 wavelength plate to the emission spectrum of the light source as a phase contrast plate 504 is used. The extended high polymer film which has about 1/2 wave of high transmission to the emission spectrum of the light source as a phase differential plate, for example, polyvinyl alcohol, a polycarbonate, Pori Sall John, polystyrene, polyarylate, etc. can be used. In addition, the liquid crystal layer which arranged a mica, Xtal, or a molecule shaft with the one direction, and carried out orientation can be used.

[0287] In addition, there is a wavelength dependency (wavelength dispersion) of a refractive index in the transparent body which generally constitutes a phase contrast plate, and engine performance sufficient with one kind of phase contrast plate is not obtained to light with a large wavelength band like the white light. Then, it is good to be made to realize 1/2 wavelength plate corresponding to a large wavelength band by shifting the optical axis and making the phase contrast plate with which two kinds of wavelength dispersion differs rival.

[0288] As a graphic display, LED501 and a collimate lens 502 are the center positions of the optical plane of incidence of two or more translucency members 506 which constitute the polarization separation prism array 509, and are arranged in the location where the polarization separation side 503 is formed in the junction interface corresponding to the travelling direction of the light which carries out outgoing radiation from LED501. That is, two or more LED501 and a collimate lens 502 are arranged in the shape of a train, while even the width of face of the optical plane of incidence of the translucency member 506 opens spacing of a part. Moreover, the

phase contrast plate 504 is arranged while even the optical outgoing radiation side of the translucency member 506 opens spacing of the width of face of a part in the optical outgoing radiation side of the translucency member 506 through which the light which reflected in respect of [503] polarization separation among the optical outgoing radiation sides of the polarization separation prism 501, and was reflected further in the reflector 505 passes.

[0289] The polarization conversion means 510 is connected so that it may combine with the end face of a transparent material 103 optically. That is, the polarization conversion means 510 and a transparent material 103 are combined with the transparence adhesives near the refractive index of the translucency member 506 which constitutes a transparent material 103 and the polarization separation prism 501.

[0290] A liquid crystal panel 200 is good to use the liquid crystal panel arranged so that the linearly polarized light transparency shaft of the polarizing plate 201 by the side of illumination-light incidence may become the longitudinal direction of minute dip reflector 103A (triangular groove to constitute) of transparent material 103 rear face, and parallel. In this example, the IPS (In Plane Switching) liquid crystal panel which was explained in (the example 7) and which carried out orientation division is used.

[0291] Next, actuation of this display is explained, referring to a drawing.

[0292] It converges according to an operation of a lens 502, and after divergence light 3005 which carried out outgoing radiation from LED501 is parallel-ized, incidence of it is carried out to the polarization separation prism array 509. The light which carried out incidence to the polarizing prism array 509 is divided into two kinds of different linearly polarized lights linearly polarized lights and the oscillating direction of an electric vector cross at right angles as the reflected light and the transmitted light in the polarization separation side 503, respectively. The light which penetrated the polarization separation side 503 is s-polarized light to minute dip reflector 103A of transparent material 103 rear face, and the light reflected in respect of [503] polarization separation is p-polarized light to minute dip reflector 103A of transparent material 103 rear face.

[0293] Incidence of the optical 3005A which penetrated the polarization separation side 503 is carried out to a transparent material 103 to minute dip reflector 103A of transparent material 103 rear face with s-polarized light.

[0294] On the other hand, it reflects further in a reflector 505, the travelling direction turns into the light and this direction which penetrated the polarization separation side 501, and incidence of the light reflected in respect of [503] polarization separation is carried out to the phase contrast plate 504. In case optical 3005B which carried out incidence to the phase contrast plate 504 penetrates the phase contrast plate 504, in response to an operation of the phase contrast plate 504, the oscillating direction of an electric vector serves as s-polarized light to minute dip reflector 103A of the linearly polarized light rotated 90 degrees, i.e., transparent material 103 rear

face, and incidence of it is carried out to a transparent material 103.
[0295] That is, after the unpolarized light which carried out outgoing radiation from LED501 which is the light source is changed into the specific linearly polarized light (it is s-polarized light to minute dip reflector 103A of transparent material 103 rear face), incidence of it is carried out to a transparent material 103.
[0296] The light which resulted in minute dip reflector 103A of transparent material 103 rear face among the light which the light 3005A and 3005B which carried out incidence to the transparent material 103 spreads the inside of a transparent material 103, repeating total reflection, and spreads the inside of a transparent material 103 changes whenever [angle-of-reflection], and separates from them and carries out outgoing radiation of the total reflection conditions by transparent material surface 103C.
[0297] Under the present circumstances, the light which spreads the inside of a transparent material 103 is s-polarized light or light with many s-polarized light components to minute dip reflector 103A of transparent material 103 rear face, and to minute dip reflector 103A, the light which is s-polarized light changes the travelling direction of light with s-polarized light, and carries out outgoing radiation from a transparent material 103.
[0298] That is, since the light which carries out outgoing radiation from a transparent material 103 is light with many s-polarized light components to dip reflector 103A of transparent material 103 rear face, the illumination light with many linearly polarized light components with the oscillating direction of an electric vector parallel to the longitudinal direction of minute inclined plane 103A of transparent material 103 rear face will be obtained from a lighting system 100.
[0299] The light which carried out outgoing radiation from the transparent material 103 is irradiated by the liquid crystal panel 200 after quantity of light distribution and the angular distribution of the illumination light are equalized with the diffusion plate 105. Under the present circumstances, in order that the diffusion plate 105 may maintain a polarization condition, the polarization condition of the outgoing radiation light from a transparent material 103 reaches a liquid crystal panel 200, while it had been maintained. The amount of transmitted lights is controlled according to image information, and, as for the light irradiated by the liquid crystal panel 200, an image is displayed on an observer.
[0300] Since it constituted so that it might become parallel [the transparency shaft of the linearly polarized light of the polarizing plate 201 by the side of the lighting system of a liquid crystal panel 200] to the longitudinal direction of minute dip reflector 103A of transparent material 103 rear face which constitutes a lighting system as above-mentioned, most illumination light contributes to a display, without absorbing almost with the polarizing plate 201 by the side of the lighting system of a liquid crystal panel 200.
[0301] That is, after being efficiently changed into the desired linearly polarized light,

the outgoing radiation light which is the unpolarized light from the light source 501 is irradiated by the liquid crystal panel 200, and it contributes to a display, without absorbing almost with a polarizing plate 201. Therefore, since it is absorbed with the polarizing plate 201 of a liquid crystal panel 200 and the light which was useless can be used effectively conventionally, a bright and low power display is realizable.

[0302] In addition, although optical 3005C which carried out incidence to the opening 207 among the light irradiated by the liquid crystal panel 200 is used for a display as it is, optical 3005D which carried out incidence to the non-opening 206 of a liquid crystal panel 200 does not contribute to a display, but reflects and returns to a lighting system 100.

[0303] Optical 3005D which returned to the lighting system 100 penetrates the diffusion plate 105 and a transparent material 103, it reflects with a reflecting plate 104, and it penetrates a transparent material 103 and the diffusion plate 105 again, and is irradiated by the liquid crystal panel 200. Under the present circumstances, at this example, by transparency of the diffusion plate 105 and a transparent material 103, and echo with a reflecting plate 104, the polarization condition of light is maintained and does not change a lot. For this reason, since optical 3005D again irradiated by the liquid crystal panel 200 is maintaining mostly the polarization condition when being first reflected by the non-opening 206 of a liquid crystal panel 200, it can be contributed to a display, without absorbing almost with a polarizing plate 201. Namely, in the display of this example, since the light which was shaded by the non-opening 206 of a liquid crystal panel 200, and was not able to contribute to a display is reusable in the condition that there is no big loss, conventionally, even if it is a liquid crystal panel with a low numerical aperture, it is effective in a bright display being obtained.

[0304] While having the function to change into the desired linearly polarized light the light source light which is unpolarized light also in this example, after reflecting once with the reflecting plate 104 of transparent material 103 rear face, the return light from the non-opening 206 of a liquid crystal panel 200 only penetrated 1 **** of a transparent material 103 and the diffusion plates 105, and is again irradiated by the liquid crystal panel 200. For this reason, absorption with a reflecting plate 104, and the transparent material 103 and the diffusion plate 105 of return light from the non-opening 206 and turbulence of a polarization condition are small, and can reuse the return light from the non-opening 206 more efficiently.

[0305] Therefore, since the effectiveness shows up more notably in the lighting system of this example, and the display using this when what has a numerical aperture low as a liquid crystal panel is used, combination with liquid crystal panels with a comparatively low numerical aperture, such as an IPS liquid crystal panel, or the liquid crystal panel which became a low numerical aperture by highly minute-ization is suitable as a liquid crystal panel.

[0306] Moreover, in the lighting system of this invention, distance to the width of face

of a transparent material, i.e., the light source side edge side of a transparent material, and this and the end face which counters cannot be depended on the magnitude of a liquid crystal panel display, but can be set up short. If the width of face of a transparent material becomes short, the propagation distance of the light which spreads the interior of a transparent material will become short. For this reason, since propagation distance of light will be short made if it is the lighting system of this invention even when the transparent body which has the refractive-index anisotropy of a minute amount like acrylic resin is used as a transparent material, change of a polarization condition is small, and ends and the lighting system which carries out outgoing radiation of the illumination light with many predetermined linearly polarized light components efficiently can be realized.

[0307] Moreover, in this example, the effectiveness of the following [using LED as the light source] is acquired. That is, since the magnitude of a light-emitting part is very small compared with a fluorescent lamp, LED is easy to raise the directivity of light by optical members, such as a lens. Here, the directive high light of the effectiveness which generally changes the light of unpolarized light into a predetermined polarization condition is higher. That is, since it is efficiently convertible for polarization (linearly polarized light which is not absorbed with the polarizing plate by the side of liquid crystal panel light incidence) of a request of the unpolarized light which carried out outgoing radiation from the light source by using LED as the light source, the utilization effectiveness of light source light can be raised more.

[0308] Moreover, the inverter which is needed with a fluorescent lamp becomes unnecessary, and LED is advantageous to the miniaturization of the body of a device. Furthermore, since LED hardly uses mercury, it has the features of being environment-friendly.

[0309] (Example 10) The example of the lighting system of the others which start this invention next, and the display using this is explained using a drawing. drawing 27 shows the outline configuration of the lighting system of this invention, and the display which used this -- it is a perspective view a part and drawing 28 shows the whole display configuration of this example.

[0310] This example consists of a liquid crystal panel 200 and a lighting system 100 which can carry out region rate lighting of the screen of a liquid crystal panel 200 independently. That is, it constitutes so that field a-c which divided the screen of a liquid crystal panel 200 into three equally in the vertical direction may be independently illuminated, respectively with three unit lighting systems 1000a-1000c which constitute a lighting system 100, and corresponding to the display action of a liquid crystal panel 200, it constitutes so that burning of three unit lighting systems 1000a-1000c which constitute a lighting system 100, and putting out lights may be controlled according to an individual.

[0311] The lighting system 100 of this example is good to use what was fundamentally

explained in the above-mentioned example. Although the case where a cold cathode fluorescent lamp is used as the light source is explained hereafter here, this invention is not limited to this. Moreover, detailed explanation is omitted about the above-mentioned example and a common part.

[0312] The scan driver (scan electrode actuation circuit) 3 and the image driver (pixel electrode actuation circuit) 4 are connected to the liquid crystal panel 200, and a power circuit 5 and the lighting driver (lighting control circuit) 6 are connected to a lighting system 100. Moreover, the liquid crystal controller 1 is connected to the scan driver (scan electrode actuation circuit) 3, the image driver (pixel electrode actuation circuit) 4, and the lighting driver (lighting control circuit) 6.

[0313] Corresponding to the display action of a liquid crystal panel 200, for the purpose of dotage prevention of a dynamic image, the lighting driver 6 controls two or more unit lighting systems 1000a-1000c which constitute a lighting system 100 according to an individual, and carries out region rate lighting of the screen of a liquid crystal panel 200 in this configuration.

[0314] As for a liquid crystal panel 200, the response time of liquid crystal uses the quick thing of the speed of response for 9 or less ms. There is a thing using the ferroelectric liquid crystal as a quick liquid crystal panel of the response time or a thing using OCB (Optically Compensated Bend) mode. Moreover, what fills the above-mentioned requirements with things, such as TN liquid crystal panel and an IPS liquid crystal panel, narrow-gap-izing a liquid crystal layer using the liquid crystal ingredient of hypoviscosity is realizable.

[0315] In this example, as a liquid crystal panel 200, as for this invention, the response time in about 2 micrometers and halftone is not limited for it to this, although the gap of a liquid crystal layer explains the case where the IPS liquid crystal panel of the Nor Marie Close property is used for 9ms.

[0316] The liquid crystal controller 1 incorporates a signal from the exterior, and outputs the data displayed on a liquid crystal panel 200, and Horizontal Synchronizing signal HSYNC and Vertical Synchronizing signal VSYNC. The configuration changes with signals into which the liquid crystal controller 1 is inputted. Here, the case where an analog signal is inputted into the liquid crystal controller 1 is explained first. In this case, the analog signal is superimposed on the image start signal which shows initiation of the signal which should be displayed with a liquid crystal panel 200, and the video signal in every pixel. The liquid crystal controller 1 contains an A/D converter, a video signal is taken out from the analog signal on which it was superimposed, and with an A/D converter, is changed into a digital signal and outputs it as data. Moreover, while outputting the image start signal of an analog signal as Vertical Synchronizing signal VSYNC, the sampling clock in an A/D converter is outputted as Horizontal Synchronizing signal HSYNC.

[0317] When the signal inputted into the liquid crystal controller 1 is a digital signal, the data by which this signal was generated with the external processing unit are

inputted. In this case, since the liquid crystal controller 1 considers data, Horizontal Synchronizing signal HSYNC, and Vertical Synchronizing signal VSYNC as an input in order that an external processing unit may perform an operation based on Vertical Synchronizing signal VSYNC and Horizontal Synchronizing signal HSYNC, this inputted data, Horizontal Synchronizing signal HSYNC, and Vertical Synchronizing signal VSYNC are outputted as it is.

[0318] Vertical Synchronizing signal VSYNC outputted from the liquid crystal controller 1 and Horizontal Synchronizing signal HSYNC are inputted into the scan driver 3. In the scan driver 3, a shift register 8 generates the signal for every scan electrode of a liquid crystal panel 200, by the level shift circuit 9, the level of the signal for every scan electrode is determined, and the signal of a scan electrode is outputted.

[0319] The image driver 4 inputs Horizontal Synchronizing signal HSYNC and Vertical Synchronizing signal VSYNC as the data outputted from the liquid crystal controller 1. Data are inputted into a shift register 10 and inputted into the line graduation 11 as data for one line. Next, level is determined by the level shift circuit 12 and it is changed into an analog signal by D/A converter 13. The changed analog signal is outputted as a signal to each pixel electrode of a liquid crystal panel 200.

[0320] Next, the lighting driver 6 which controls the unit lighting systems 1000a-1000c which constitute a lighting system 100 according to an individual is explained.

[0321] It connects with the light sources 101a-101c of a power circuit 5 and the unit lighting systems 1000a-1000c, and the lighting driver 6 controls burning of the unit lighting systems 1000a-1000c which constitute a lighting system 100, and putting out lights according to an individual, in order to prevent the dotage which is generated in the case of an animation display.

[0322] Drawing 29 shows the configuration of the lighting driver 6. The lighting driver 6 consists of counters 61, 62, and 63, pulse generators 64, 65, and 66, switches 67, 68, and 69, and inverters 70, 71, and 72. Counters 61-63 input Horizontal Synchronizing signal HSYNC, respectively, and count the number of the pulses of this Horizontal Synchronizing signal HSYNC. Moreover, a counter 61 is inputted as a signal for a counter 62 to start the output signal of a counter 61 for Vertical Synchronizing signal VSYNC, and for a counter 63 start each count for the output signal of a counter 62. Pulse generators 64-66 output the signal of Hi level between the time amount it was determined beforehand that received the output of counters 61-63, respectively. When the signal from pulse generators 64-66 is Hi level, it will be in ON condition, and the power from a power circuit is inputted into inverters 70-72 by this, and the light sources 101a-101c turn on switches 67-69 according to an individual.

[0323] Drawing 30 shows the output of Vertical Synchronizing signal VSYNC, Horizontal Synchronizing signal HSYNC, and inverters 70-72.

[0324] Here, this case is explained to setting the period of Horizontal Synchronizing signal HSYNC to 15 microseconds for the period of Vertical Synchronizing signal

VSYNC for 16.6ms, and scanning the whole screen surface of the 800x600-pixel liquid crystal panel 200 for 9ms.

[0325] After the lighting system 100 consists of three unit lighting systems which divide and illuminate the screen of a liquid crystal panel 200 to three lighting fields, the scan of the field ends the unit lighting system which takes charge of each lighting field after the scan of the screen of the corresponding liquid crystal panel 200 is started, and liquid crystal answers by this example, it controls to irradiate the illumination light. Therefore, after [of since a scan is started in the field c of a liquid crystal panel 200] 12ms, and 4.6ms The illumination light is irradiated in between. Moreover, in Field b, they are after 15ms and 4.6ms. The between illumination light is irradiated and they are after 18ms and 4.6ms in Field a. The between illumination light is irradiated.

[0326] In order to realize this, a counter 61 outputs an output signal, when 800 Horizontal Synchronizing signals are counted. Similarly, a counter 62 outputs an output signal, when 200 Horizontal Synchronizing signals are counted after the counter 61 outputted the output signal, and a counter 63 outputs an output signal, when 200 Horizontal Synchronizing signals are counted after the counter 62 outputted the output signal. Moreover, each pulse generators 64-66 receive the output signal of each counter, and are 4.6ms. It is made to output the signal of Hi level in between.

[0327] Drawing 31 shows the relation between the permeability of the liquid crystal panel 200 screen in this case, and the brightness of a lighting system 100. The permeability of a liquid crystal panel shows the average of each field. Thus, after the liquid crystal of the field which should irradiate the illumination light of a liquid crystal panel answering and becoming desired permeability, the light is switched on, and the unit lighting systems 1000a-1000c which constitute a lighting system 100 are controlled to put out the light, after carrying out fixed time amount lighting.

[0328] Even if it displays the animation to which the still picture was moved at the rate with a viewing-angle rate of 10 degrees [/s] on such conditions, especially dotage of an image shall not be sensed at all. That is, the liquid crystal display which can display an animation without sense of incongruity can be offered simple.

[0329] Especially in this example, only time amount until the screen of a liquid crystal panel answers completely does not need to wait for burning of a lighting system. That is, in order to turn on a lighting system by the short standby time rather than a smaller viewing area answers, the longer time amount illumination light can be irradiated and a brighter image is obtained.

[0330]

[Effect of the Invention] According to this invention the above-mentioned passage, even when enlargement (big-screen-izing) is attained, it is lightweight and a thin shape and the lighting system with which high brightness and the luminance distribution within a field carry out outgoing radiation of the uniform illumination light

can be realized.

[0331] Therefore, in the display using the lighting system of this invention, even if a screen size becomes large, since it has not said that lowering of the brightness of a lighting system and thickness increase, the display with which the high definition display with the uniform luminance distribution within a field is obtained by the thin light weight and high brightness is realizable. Moreover, when using a liquid crystal panel as a display panel, even if the numerical aperture of a liquid crystal panel is low, it is reusing efficiently the reflected light from non-opening of a liquid crystal panel, and the display with which a brighter display is obtained can be realized.

[0332] Furthermore, since the lighting system of this invention can irradiate a liquid crystal panel after changing it into the linearly polarized light of a request of the unpolarized light which carries out outgoing radiation from the light source efficiently, efficiency for light utilization becomes high, it is a low power and the display with which a bright display is obtained can be realized.

[0333] Moreover, the flash of two or more light sources which constitute a lighting system is controlled, by carrying out region rate lighting of the liquid crystal panel independently, an animation can be displayed without sense of incongruity and a bright liquid crystal display can be realized.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] one example of the lighting system of this invention is shown -- it is an outline sectional view a part.

[Drawing 2] the outline configuration of the unit lighting system which constitutes the lighting system of this invention is shown -- it is a perspective view a part.

[Drawing 3] It is drawing showing an example of the relation between the effective thickness of the optical incidence section end face of a transparent material, and the brightness of a lighting system.

[Drawing 4] It is the fragmentary sectional view showing an example of the transparent material concerning this invention.

[Drawing 5] It is the fragmentary sectional view showing an example of the transparent material concerning this invention.

[Drawing 6] It is the fragmentary sectional view showing an example of the transparent material concerning this invention.

[Drawing 7] It is the outline perspective view showing one example of the lighting system of this invention, and the display using this.

[Drawing 8] It is the fragmentary sectional view showing one example of the lighting

system of this invention, and the display using this.
[Drawing 9] It is the outline perspective view showing one example of the transparent material concerning this invention.
[Drawing 10] It is the fragmentary sectional view showing one example of the lighting system of this invention, and the display using this.
[Drawing 11] It is the fragmentary sectional view showing one example of the lighting system of this invention, and the display using this.
[Drawing 12] It is the outline perspective view showing one example of the transparent material concerning this invention.
[Drawing 13] It is the fragmentary sectional view showing one example of the lighting system of this invention, and the display using this.
[Drawing 14] It is the fragmentary sectional view showing one example of the lighting system of this invention, and the display using this.
[Drawing 15] an example of the polarization maintenance diffusion plate concerning this invention is shown -- it is a perspective view a part.
[Drawing 16] an example of the polarization maintenance diffusion plate concerning this invention is shown -- it is a sectional view a part.
[Drawing 17] an example of the polarization maintenance diffusion plate concerning this invention is shown -- it is a sectional view a part.
[Drawing 18] It is the fragmentary sectional view showing one example of the lighting system of this invention, and the display using this.
[Drawing 19] It is the fragmentary sectional view showing one example of the lighting system of this invention, and the display using this.
[Drawing 20] It is the fragmentary sectional view showing one example of the lighting system of this invention, and the display using this.
[Drawing 21] It is drawing showing whenever [optical incident angle / of the minute dip reflector formed in the rear face of the transparent material concerning this invention], and the relation of a reflection factor.
[Drawing 22] It is the front view showing a 1-pixel example of the liquid crystal panel concerning this invention.
[Drawing 23] It is the explanatory view of the configuration of the liquid crystal panel concerning this invention.
[Drawing 24] It is the fragmentary sectional view showing one example of the lighting system of this invention, and the display using this.
[Drawing 25] It is the fragmentary sectional view showing one example of the lighting system of this invention, and the display using this.
[Drawing 26] an example of the polarization conversion means concerning this invention is shown -- it is a sectional view a part.
[Drawing 27] It is the outline perspective view showing one example of the lighting system of this invention, and the display using this.
[Drawing 28] It is the outline block diagram of the display of this invention.

[Drawing 29] It is the outline block diagram of the lighting driver concerning this invention.

[Drawing 30] It is the explanatory view of the lighting driver concerning this invention of operation.

[Drawing 31] It is the explanatory view showing an example of the relation of the liquid crystal panel permeability of the display of this invention, and the brightness of a lighting system.

[Drawing 32] It is the fragmentary sectional view showing one example of the lighting system of this invention.

[Description of Notations]

1 [-- Power circuit,] -- A liquid crystal controller, 3 -- A scan driver, 4 -- An image driver, 5 6 -- 8 A lighting driver, 10 -- 9 A shift register, 12 -- Level shift circuit, 11 -- Line memory, 13 -- A D/A converter, 61, 62, 63 -- Counter, 64, 65, 66 -- A pulse generator, 67, 68, 69 -- A switch, 70, 71, 72 -- Inverter, 100 -- A lighting system, 101,101a, 101b, 101c -- Light source, 102,102a, 102b, 102c -- A lamp cover, 103,103a, 103b, 103c -- Transparent material, 103A -- The minute dip reflector on the rear face of a transparent material, 103B -- The principal plane on the rear face of a transparent material, 103C -- A transparent material front face, 103L -- The lobe of a transparent material, 103M -- Optical convergence section, 104,104a, 104b, 104c -- A reflecting plate, 105 -- Diffusion plate, 106 -- A cholesteric-liquid-crystal layer, 107,108,504 -- Phase contrast plate, 109 -- A linearly polarized light separation component, 200 -- A liquid crystal panel, 200A -- The screen perpendicular of a liquid crystal panel, 201,205 -- A polarizing plate, 202,204 -- A transparence glass substrate, 203 -- Sealing compound, 206 [-- LED,] -- Non-opening, 207 -- Opening, 208 -- A liquid crystal layer, 501 502 [-- Translucency member,] -- A lens, 503 -- A polarization separation side, 505 -- A reflector, 506 509 -- A polarization separation prism array, 510 -- A polarization conversion means, 701 -- Linearly polarized light separation component, 1000, 1000a, 1000b, 1000c -- 1031 A unit lighting system, 1032 -- The end face of a transparent material, 1501 -- A transparence base material, 1502 -- A transparence bead, 1503 -- Transparence adhesion resin, 2001 -- A video-signal electrode, 2002 -- A pixel electrode, 2003 -- Common electrode, 2004 [-- A lobe, 3234 / -- A plane of composition, 10311 / -- The end face of the transparent material in which light source light carries out incidence 10312 / -- Junction end face with an adjacent transparent material.] -- A scan signal electrode, 3231 -- A plate-like transparent material, 3232 -- A wedge shape transparent material with a lobe, 3233